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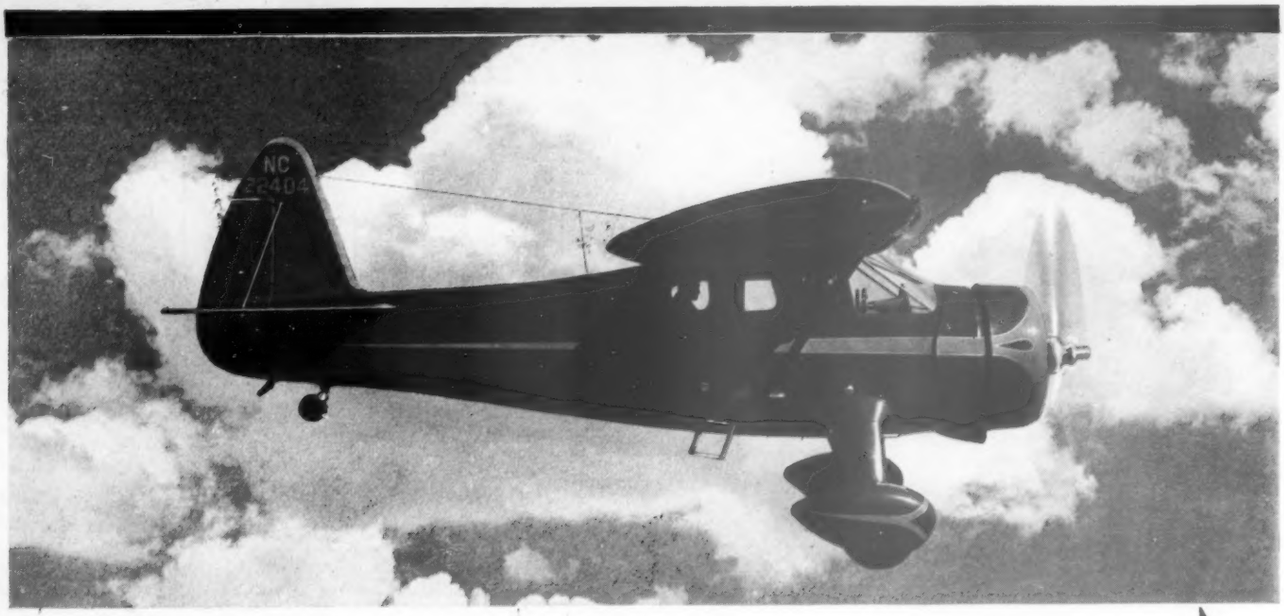

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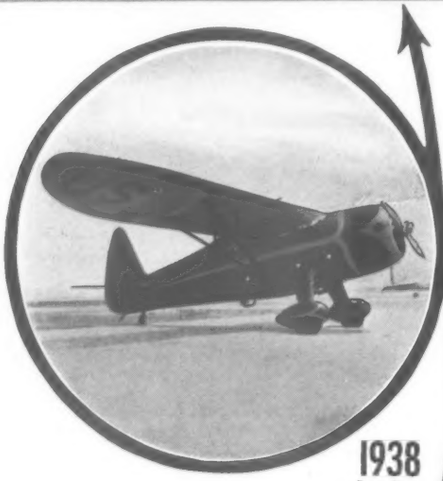

1938
Receives Government orders—larger production

1937
Company incorporated
FIRST PRODUCTION

1935
Mister Mulligan—first of the Howard Cabin Planes

1936
First Commercial Model
(A.T.C. Granted)

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Picked Up Along Editorial Airways

» HOCUS POCUS and mumbo jumbo are meat and drink for most Congressmen, but few Congressional committees have been subjected to such a barrage of scientific abacadabra as was handed out by one Willis G. Waldo to the Senate Committee on Military Affairs at the hearings on S-1738, a "bill authorizing the establishment and authorization of a military aircraft engineering center to determine costs . . . and for other purposes . . ." For students of government literature, the transcription of the hearings is a "must" item. A reading of the hearings left us with a confused vision of airplane motors made out of lithium bobbing about on water like corks, and of armor-plate and smokeless powder rampant on a field of beryllium. When we finally got our feet on the ground again we were left with more than a vague notion that the author's real interest lay in getting in a few good licks for the Tennessee Valley Authority behind a smoke screen of aviation publicity. The bill contains dynamite, and the congress may be taken in by the glib recitation of its promoter's scientific "facts" if someone doesn't set them straight. We suggest as a starter a careful reading of T. P. Wright's article in June AVIATION.

» MOST SENSIBLE of all the boys who have gassed up their 50 horse chariots and pushed out to sea this spring was the lad who stated frankly that he was headed for Mars. He, at least, was under no illusion that fame and fortune lay just over some North Atlantic horizon. He knew what the score was,—that that racket was long since dead. What with the Clippers ploughing back and forth on schedule, and all that, and the fame of Corrigan the Great long since dimmed far beyond the power of any Hollywood build-up to add or detract, he naturally looked for possibilities in other directions. To be the first to land on Mars on 50 h.p. and a gallon and a half of gas! Oh, Boy!—that would be news! He really had something there, but all he got out of it was a ducking.

» LESS FORTUNATE were several others. We had hoped that we would never again have need to drag out our "stock" comments on the futility and foolishness of single-handed, single-engined attempts to span oceans, or other such-like efforts for the sake of sweet publicity. But since there seems to be a new rash of Atlantomania breaking out all over the place (perhaps the World's Fair atmosphere may have something to do with it, or maybe it's just the Silly Season), it seems necessary to dig down into the moth-balls and bring some of them out for an airing. In October, 1936, we said—"we . . . deplore the survival of a state of mind (which should have been long since extinct) that sends a Beryl Markham out over the Atlantic alone, without radio in the face of definitely bad weather. . . . Ten years ago there might conceivably have been some justification for such attempts. Today we can see none whatsoever. . . ." Later (July, 1937), apropos of the disappearance of Amelia Earhart—"we believe the time long since past for great solo achievement in aviation. Today is the day of the carefully planned, scientifically backed, group development . . . commercial ocean flying is now the most important field for the future." As for Corrigan,—Dan Sayre, comparing his flight with Lindbergh's said (August, 1938)—"in fact, the whole adventure had much of the quality of the re-performance in Boston each year of the famous ride of Paul Revere. . . . All that is missing is the fact that the original ride served a real, and indeed pressing purpose; the re-performance, none." And we see no reason for changing our attitude on the subject, come late spring, 1939.

» UNJUSTIFIABLE RISK is the only way we can look upon any attempt to span the Atlantic today in single engined equipment, without benefit of multiple crews, and without every possible aid to navigation, the fullest radio equipment, and the most exhaustive study of weather conditions. The most important problem facing aviation today is to make ocean crossings safe, comfortable and economical. But the answers will come out of well financed, carefully planned, and cautiously executed programs set up by competent groups, and not out of the hit-or-miss efforts of adventurous individuals putting most of their reliance on Lady Luck.

» BALANCE OF POWER in Europe is shifting rapidly this spring, due chiefly to the great improvement in aircraft production in Great Britain. There is no doubt but that England at long last is definitely out to eliminate the great disparity that existed a year ago between her air forces and Germany's. There seems to be little doubt that British output is approaching three times the figure of last fall, and by the fall of 1939 it may easily multiply it by four. Some British sources have let it be known that this has already been achieved. Lord Beaverbrook announced not long ago that production had reached the

MAINTENANCE

THIS issue is dedicated to the maintenance men on the Airlines, in the Services, in Fixed Base activities, and at airports everywhere, who, by their constant care and attention to their jobs, have made possible the outstanding operating and safety record set by aviation in America.

As Colonel Sumpter Smith points out in his introductory message, good maintenance is the very essence of safe aircraft operation. Too much credit could not be given to the work of the Maintenance Committee, organized first under the Aeronautical Chamber of Commerce, and now carried on under the Air Transport Association. The Committee has not only done a remarkable job of coordination and standardization of practices and equipment, but has made the results of its work fully available to the Army, the Navy, the commercial operators, the Aviation schools, and the manufacturers. Too much credit for the success of the Committee's work could not be given to A.T.A. Secretary Fowler W. Barker. He has given unreservedly of his time and energy to a most important job, and has successfully steered the Maintenance Committee through many difficult years.

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1,000 plane per month level. C. G. Grey and others to the contrary, however, this sort of figuring is probably intended for home consumption and contains a certain amount of eyewash. Continual checking from a number of reasonably reliable sources would indicate that the present output of *complete* military machines in England is probably in the neighborhood of 700 per month.

» LARGEST FACTOR in Britain's production improvement is undoubtedly the coming into production of the Shadow Plants. It was apparent in visiting some of them in October and November, 1938, that there had been plenty of difficulties involved in getting them started, that production up to the first of the year had been disappointing. The fact that the total British production figures have jumped so sharply since the first of the year is a good indication that most of the "shadow" trouble seemed to be over, and plants are now producing up to expectations that were not realized in 1938.

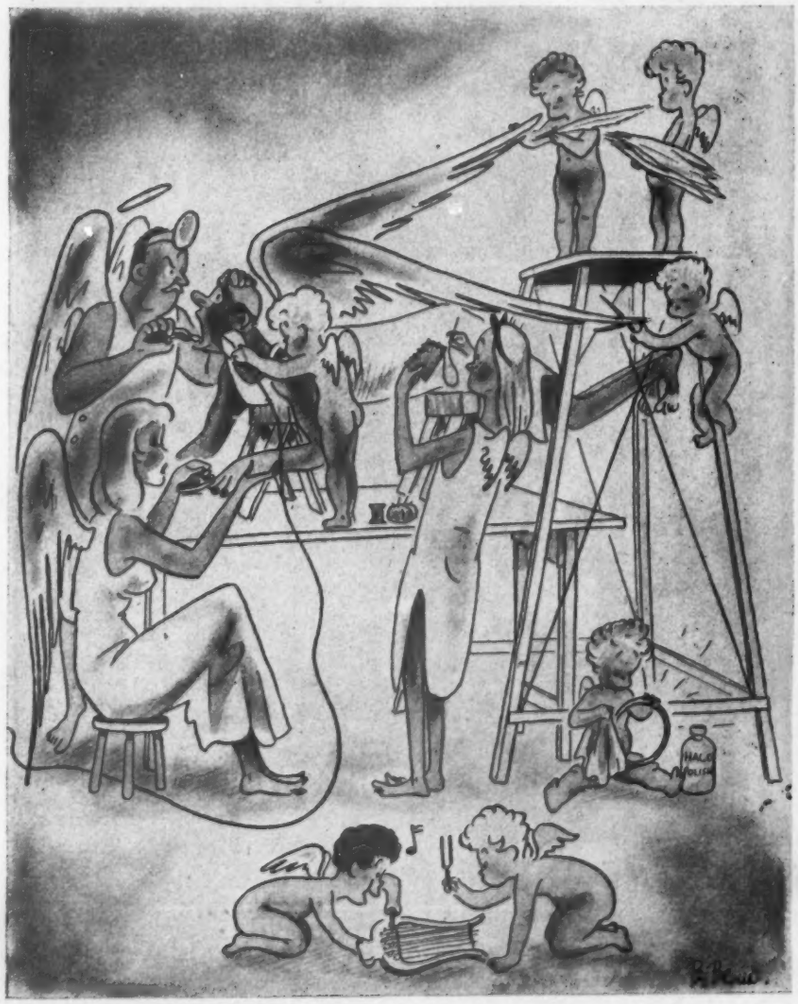
» GREAT QUESTION MARK is still Russia. As we pointed out in "Box Score" in January, she really holds the balance of aviation power in Europe. She is in a strong bargaining position and she apparently knows it, judging from events of the past few weeks. Her decision to go with the British and French, or to cast her lot with the Rome-Berlin axis (either actively, or by refusal to participate in a general war) may change the entire course of history within the next few months.

» C.A.A. REPORT on the loss of the Boeing Stratoliner near Alder, Washington, on March 19 is a most interesting document and probably one of the soundest analyses of any major aircraft accident that we have had yet. CAA investigators and Boeing engineers are to be congratulated for their joint efforts in reconstructing so ably the probable sequence of events from very sketchy evidence. It is unfortunate that certain press stories concerning the report put results ahead of causes in announcing that structural failure was the attributable cause of the accident.

The CAA report brings out very clearly that the failure was secondary, and was due to the imposition of excessive loads in a too abrupt pull-out from an inadvertent spin. All accidents of this sort are, of course, regrettable, but they can contribute greatly to the advancement of aviation if they can be fully aired and if the contributing causes can be determined.

» THE MAINTENANCE AWARD, which goes to United Air Lines for the calendar year 1938, was established by this magazine in 1936. It is given every year in recognition of outstanding contribution to the field of aircraft maintenance. First recipient was Walter Hamilton of TWA, long outstanding in airline maintenance and an active participant in maintenance committee affairs. At the time of the award, he had been chairman of the committee for two years. For the second year (1937), the award went to American Airlines. United is the third recipient. Selection for each year is in the hands of a committee of disinterested experts. Scoring for the award is based on a comparative study of such elements as number of types of airplanes and engines in service; average airplane hours flown per day; ratio of maintenance to other personnel; per cent annual expense to maintenance; per cent capital investment in maintenance and shop equipment; delays for mechanical reasons per airplane miles; policy of encouragement of new developments for safety through maintenance, etc.

» OUR LATIN COUSINS should find considerable use for a little book that has just appeared from Aviation Press of San Francisco. C. T. Reid, assistant chief draughtsman of the Douglas Company, has turned out an aeronautical dictionary in English-Spanish and Spanish-English. The coverage and the definitions seem quite adequate for normal aviation purposes. Might be a good thing to include something of this sort with sales information and operating instructions to the more important customers in the Spanish-speaking countries.



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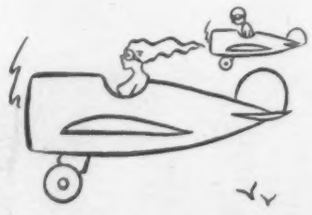
Side Slips

By
ROBERT OSBORN

» EVERY ONCE IN A WHILE we wonder what ever became of that inventor who mailed us an idea for "spreading the center of gravity all over the airplane instead of locating it all in one spot, thereby saving on the structural weight of the airplane."

There was a man with an idea.

» A YOUNG LADY PILOT out California way was slightly injured in a forced landing with her disabled plane and explained that she had to take the chance of landing the ship as she had been taking a nudist sun bath



aloft and was in no fittin' condition to take to her parachute.

We think it advisable at this time to warn all male pilots that the C. A. A. still has strict regulations against flying too close to other aircraft.

» "MECHANICS will scrape and oil to protect it from the salt air on the Fronk the salt on the log review on the salt air on the long voyagy to Leninbrad aboaf the Soviet freighter Alto Tta." From *N. Y. Herald Tribune* story about the Russian transatlantic plane.

Our deduction, Dr. Watson, would be that the linotype operator had gotten a little oiled himself, as protection against that salt air.

» ON THE NORTHERN ROUTE of Pan American, scheduled for opening June 24th, one of the stops is at Shediac, N. B. Probably it isn't important enough for Pan American to consider changing the whole route around, but think how much fun their station announcer could have if the next two stops on the line had names like Meshack and Abednego.

» SEEMS to have been a bit of controversy going on about one of the statues at the New York World's Fair. The newspapers describe the statue as consisting of a lady and gent, completely naked, standing in front of a bird having three wings, which is riding on a rainbow. In the dedication ceremony Mayor LaGuardia said it was a symbol of Aviation of the future. Whereupon Mrs. Whitney, the sculptress, stated it didn't have anything to do with Aviation at all but indicated that youth was looking forward and upward into the future.

From a rational defense standpoint we wish Mrs. Whitney had not corrected that interpretation as a symbol of Aviation of the future. It would have scared the rambunctious dictators plenty to think that we might actually build a fleet of military aircraft that looked like that.

» EVER SINCE the boys began claiming new world's records for carrying electric stoves in airplanes for the first time we've been thinking the F.A.I. would have to put up a new building in which to file all of the odd records people were establishing. Speed record over a closed course of 1852.5 kilometers carrying 16.2 kilograms of payload; distance record in a twin-engined airplane with only one engine operating carrying four men, an iron soup kettle and eight penguins,—and so on.

The latest one is: A young lady in Russia is now claiming the Women's World's endurance record for Stratosphere Sphericals by remaining aloft 22 hours and 44 minutes.

» THE PRESIDENT has set aside August 19th of each year as National Aviation Day following the suggestion of a joint resolution by Congress. Considering the backlogs of orders in the airplane and engine factories and the rapidly increasing business of the air lines we imagine the holiday will be celebrated this year by working a twelve hour day on two shifts, as usual.

» A RECENT NEWSPAPER ARTICLE stated that the fine service now offered by the air lines enables easterners to reach the western dude ranches in much faster time.

It must be very satisfying to the

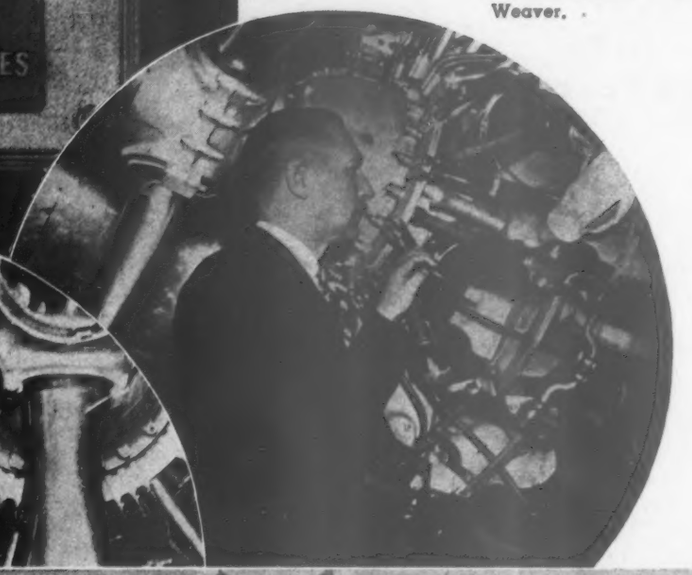
pioneers of our air transport lines to know that all those years of hard work and devotion to duty were worth while after all.

» "LOS ANGELES, May 16.—(INS)—Accompanied by technical experts from the Australian royal air force, Wing Commander E. C. Wackett arrived in Los Angeles harbor today to supervise the building of 50 bombers for Australia."—News Item.

Come, come, you California boosters. That's pushing us a bit too far. We know there have been a lot of new factory buildings put up out there recently but you can't make us believe there isn't any dry land space left for manufacturing airplanes.

★ ★ ★ ★ ★ ★

AVIATION'S Maintenance Award, established in 1936, which goes to United Air Lines for the year 1939.



United's superintendent of maintenance, Buck Weaver.

United Air Line's superintendent of overhaul, Ray Dehority.

The Cheyenne shop personnel. In circle, Bill Hoare, who supervises maintenance and overhaul at the base.

AVIATION *for July, 1939* ★ ★ ★ ★

MAINTENANCE for SAFETY

A Message to the Airline Maintenance Committee

By Sumpter Smith

Chairman, Air Safety Board Civil Aeronautics Authority

THE airlines of the United States lead the airlines of the world in safety of operation. Much of the credit for this excellent performance record can be attributed to the cooperation that has existed between the maintenance departments of the various airlines, which is best exemplified by the hard work of the maintenance committee.

With interest, I have followed the work of the maintenance committee. This has been particularly true this last winter when government forces joined with the airlines in a concentrated safety campaign. Everyone is now aware of the results; the airlines attained a new standard of safety for operations during the period of the year which previously had the poorest safety record. Complete cooperation, forceful coordination and stringent regulations on the part of the Civil Aeronautics Authority backed by critical, unbiased investigations conducted by the Air Safety Board would not have given the results obtained without the excellent cooperation and hard work of the airlines, particularly maintenance departments.

For the past five or six years the work of the maintenance departments of the various airlines has been coordinated by the maintenance committee. Ideas have been exchanged; problems have been discussed; and when one line has failed in a complete solution, another frequently has found the answer. Consequently, the experience of all lines has been made the experience of each line. Their maintenance work has been coordinated and the results have been a great deal more effective.

The maintenance committee as a unit, and each individual member of the committee is to be congratulated for the part they have played in establishing the airline operation safety record, and a special word of praise is to be said for the Air Transport Association in the coordinating work of its member of the committee.

The work of the maintenance departments of the various airlines has not only resulted in establishing new records in safety of operations, but to these departments goes much of the credit for the development of new, more dependable and efficient power plants. Close cooperation between engine manufacturer and airline maintenance personnel is responsible for this development. Through this creative work of the maintenance departments, contributions have been made to general aeronautical development and thereby to the national defense of this country.

While the work of the maintenance departments is to be lauded, they still have a job ahead of them. If they do nothing else, matching their past record will give them an appreciable task. I have confidence, however, that they will go still further under the continued guiding hand of the maintenance committee. New developments will bring new problems and some of the old problems have not been entirely solved. It is to be remembered that one accident costing life and property is too many, and a vigilant guard against such occurrences always must be maintained.

Who's Who IN AIRLINE MAINTENANCE

Probably the greatest contribution to airline safety in America has been through the cooperative work of the Maintenance Committee of the A.T.A. Here is the story of how it all came about, by the man who has been largely responsible for the remarkable success of the whole project.

By Fowler Barker

Secretary, Air Transport Association of America

THE Air Line Engineering and Maintenance Committee has been functioning with cumulative results for eight years. Things happen so rapidly in air transportation that annual conferences of this sort are too far apart, even though they are held each six months. Were it not for the fact that members of the committee continuously exchange information, the semi-annual meetings would also be too infrequent.

The maintenance chief of each U. S. air line is a member of the committee. In recent years when the air lines either elevated these men to the title of chief engineer or employed chief engineers, the latter have been taken into the fold. And it is a "fold." The committee is a closed corporation, has done a good job and knows it. Several of the original members are still "in good standing." Luther Harris, now of Pennsylvania Central, was the first chairman when the committee was organized in 1931 under the Aeronautical Chamber of Commerce with William Berchtold as secretary. André Priester is another charter member and a valuable contributor.

Walter Hamilton of TWA, one of the original members, was chairman from the Kansas City meeting of June, 1933, until the Hollywood conference of 1936 when he was succeeded by H. O. West now of Trans-Canada Airlines, who, at that time, was in charge of Engineering and Maintenance for United Air Lines. It was Oliver West who emphasized the engineering phase beginning with the Boston meeting held in July of 1937, thus dividing the scope of the meetings, more formally at least, to (1) making plans for the future (engineering for the long pull) and (2) licking immediate problems. Great credit is due Luke Harris and Walt Hamilton for keeping the meetings on the informal basis of round table free discussions of troubles and how they were being licked or had been licked by one or more operators. This is for the benefit of all, and due to the suggestion of Colonel E. S. Gorrell, President of the Air Transport Association of America, pertinent air line technical data in recent years have been made

LUTHER HARRIS.
First Chairman, Maintenance Committee
Maintenance Superintendent, P.C.A.

WALTER HAMILTON.
Ex-Superintendent of Maintenance, TWA
Now with Douglas Aircraft

OLIVER WEST.
Former Maintenance Supt., U.A.L.
Now T.C.A.'s Chief Engineer

HUMPHREY TOOMEY.
Ex-U. S. Navy.
Now Division Engineer, P.A.A., Miami

Strictly Confidential

ALTHOUGH "strictly confidential," here are some of the high spots which can be talked about, gleamed from recent minutes of Airline Engineering and Maintenance Committee conferences:

Average air transport engine power output has been increased 125 per cent in the past ten years . . . Four cc's of lead in 95 octane gas is believed better in present production engines than three cc's in 100 octane . . . Recommended that high-high octane be colored green, and 87 octane, blue . . . One new model transport has one mile of control cable and twelve miles of electrical wiring . . . The committee recommended that a marking strip be placed on tubing to show whether twisted . . . (Before the next meeting, this was done by an alert manufacturer!) . . . Pilots should leave flaps down until speed is slackened in order to save brakes . . . Mineral oil, because it doesn't vapor-lock, is a good fluid for hydraulic systems . . . Heat from the pilot's breath affects the accuracy of sensitive altimeters . . . By the simple expedient of reducing the diameter of a pulley, engines were made to idle properly . . . Air transports are flying between two and three thousand hours a year . . . In 1937 the air lines used more gas and oil than the Army and Navy combined.

available to the private flier and the non-scheduled commercial operator. Prior to the time that Douglas equipment was as universally employed as it is today, the maintenance chiefs and/or engineers of the air lines, including the Dutch, "went to school" to Walt, who gave them, unstintingly, what they needed to know before placing DC2's in operation. The same co-operative spirit has permeated all the meetings and applied to Northwest's experience with Electras and American Airlines' with the DC3. Both air lines passed on their valuable experiences to the others. Pan American Airways, through Messrs. Priester, Leslie, Toomey, McVitty and Sundell, and André Priester's right-hand men in New York have always been active and the essence of co-operation in giving the others the benefit of their experience. Royal Sundell succeeded West as Chairman and did an exceedingly good job, especially in lining up speakers for the formal and open sessions.

Among these speakers, beginning with and since the Dallas meeting in July of last year, have been Jim Doolittle, Bill Hubner, and Doc Barnard on a symposium of the high octane situation, Nate Price of Boeing on four-engined jobs, Igor Sikorsky on designing for the future, Andrew Willgoos and his brilliant monograph on engine design trends, Ken Browne on vibration and engine mounts, Colonel Ragsdale on stainless steel, Eddie Allen on training crews for the big ships. S. Paul Johnston was especially interesting when, on two occasions, he reported his European experiences. On the most recent occasion the Committee scooped the "Saturday Evening Post" and "Readers Digest" by several weeks when it heard what Paul had to say about European aviation with emphasis on technical developments and maintenance practices.

Conferences of the Committee with which the writer has been associated have been held at Atlanta (December 1933), in Chicago (July 1934), Brownsville (January 1935), Detroit (July 1935), Miami (January 1936), Hollywood (July 1936), Dayton (January 1937),—how many conventions have been invited to hold their meetings at Wright Field?—Boston (July 1937), Dallas (January 1938), Chicago (July 1938), and New York (January of this year). It will be noted that at each place—with the exception of Wright Field, Detroit, and New York—there has been an air line maintenance base. Wright Field and the Bureau of Aeronautics and the Navy Department have for years collaborated closely with the air lines on the subject of maintenance, and it was none other than Captain C. S. "Bill" Irvine of the Air Corps who led off with a prepared paper as a speaker before an open session at which all delegates to the Conference, including manufacturers, aviation schools, college professors, and others were invited to sit in. Captain Irvine's

CLARENCE BELINN, Formerly with Ludington, Now Supt. of Maintenance, B. & M.A.

JAMES LAMONT, Now Service Superintendent, N.W.A. A real old-timer in the business

R. M. BENJAMIN, Who heads up Overhaul and Maintenance on Mid-Continent Airlines

PAUL BRIGGS, In Charge of Maintenance Operations on Continental Airlines.

Maintenance Garden Party,—

Or "All Work and No Play Makes Jack a Dull Boy." Colonel Gorrell entertains the July, 1938 Conference at his North Shore Home. (Photos by George Paulson, B. G. Co.)

1. **Roy Sundell (P.A.A.) and Lt. Ed Perrin keep an eye on proceedings, while Isabel Barker and Carl Schorey weep silently into their beer.**
2. **The photographer interrupted an informal conference.—Conferees: Trees (Scintilla), Sundell (P.A.A.), Ellis (Stanavo), and Allen (now Boeing) are watching for the birdie. The gentleman with the startled-faun expression in the left foreground is Clarence Belinn (B. & M.).**
3. **Ray Leedom (B.G.), and friends indulge in a little coca-cola.**
4. **Eddie Allen checks up on the re-fueling situation.**
5. **The genial host welcomes some of the delegates to the garden party.**
6. **"Now you tell one" says Mr. Kerr to Mr. Hamilton.**
7. **Archery kept some of the boys hot and bothered all afternoon.**
8. **Pratt & Whitney's West Coast service manager, Bill Gwinn, looks on while—**
9. **Jim Doolittle (Shell) makes a bulls-eye.**
10. **Eddie Allen and Walter Lees (Scintilla) conduct further tests on the re-fueling problem.**
11. **Slim Lindsay (B.G.'s roving representative) on the lookout for a fast one.**
12. **Sam Barker, Maintenance Committee mainspring, tosses a pair of mean horseshoes.**

paper delivered at Boston is still considered to be the guide for manufacturers in designing an airplane to take into consideration their accessories and the maintenance of the whole.

Luke Harris informs me that the first meeting was held in Detroit during the aircraft show in 1931. The second meeting was held in Dallas in December of that year, the third in Cheyenne in July of 1932, and the fourth in Miami the following December. The Conferences have gained momentum each year, the most recent one in New York being attended by approximately 200 leaders in aviation from a technical viewpoint.

Standbys among vendors who have been present at the majority of these conferences are Roy Isaacs formerly of Eclipse and now of Pioneer, Carl Schory of Hamilton-Standard, who, for years, has acted as chairman of the manufacturer's group and aided me in herding the vendors into the conference at the proper time, Jack Bunce of Pratt and Whitney, Bill Kennedy and Ken Boedecker of Wright, George Paulson, Ray Leedom and Slim Lindsay of B.G., and the rubber triumvirate—Larry Guinther, Ray Brown, and Jim Pedler of Goodyear, General and Goodrich, respectively. Pedler and "Mike" Taylor several years ago worked closely with Committee members in developing present-day deicing equipment. "Pop" Cleveland of the Cleveland Pneumatic Tool Company has been a regular delegate. Indeed, it isn't a maintenance conference if he doesn't show. Carl Squier has represented Lockheed at these meetings for years, as did Chet Cole when he was with Douglas but who has since matriculated into the ranks of Committee members representing Eastern Air Lines, along with Charles Froesch who has taken an active part as Chairman of the Air Transport Association Committee on Aircraft Fire Prevention and Protection. The Bendix crowd are always in evidence, including Trees and Lees of Scintilla, Kerr and Miller of brake and carburetor, respectively, not to skip DuBois and even John Cautley himself, George Hobleman of Walter Kidde, who, at the New York conference was flanked by Dr. Freygang, has been a familiar figure at these meetings. Not all who have attended, and contributed to, these conferences can be mentioned in this article; their interest and help is nonetheless appreciated.

The oil companies, strangely, and not for purposes of salesmanship, have been well-represented for years. Such names as G. French, now a big oil man in California, have been succeeded by Bixler, representing Sinclair, as a regular delegate, Doolittle and Jim Wheeler of Shell, Ed. Aldrin, now Bob Ellis of Standard Oil, Colonel Lake and George Patterson of Stanavo, "Doc" Kinkade of Gulf, Major Young of Pure Oil, Dick Bradley of Standard Oil of California, Phillipar of Kendal, Aubrey Keif, Duke Jernigan, Pete Clauson, and "Doc" Haskell have represented Texaco ably, "Doc" answering questions in a true scientific manner—not in the least over the heads of the Committee. J. L. King and "Kon" Konvalinka of Pennzoil, W. E. Townsend and others of the Crusader Oil Company have been standbys and have contributed interestingly and valuably. Compounded and solvent treated oils was the theme of one of the meetings, and high octane always comes in for its share of attention.

It was brought out at the Dallas Conference in January of 1938 that there were twelve grades of aviation fuels. The Committee, in collaboration with others concerned, has been active in reducing this number. There has been a lot of talk about the effect of the use of 100-octane gasoline on the earning power of the air lines. Economies, consistent with safety, have been stressed at each one of these meetings, and this high-octane situation is but one of many items considered which have a bearing upon economy of operation.

The Committee has had the honor of having the presidents of some of the largest vendors in attendance, including Mr. Edgar of the Ethyl Corp., Mr. Wm. O'Neil of General Tire and Rubber Company and Mr. Laidlaw of the upholstery and curtain material firm, so well represented by Mr. Ed. Griffin, have attended the sessions at one time or another as has Mr. J. H. McDuffie as president of the Presto-Lite Company.

Mr. T. E. Braniff of Braniff Airways, Jack Frye of Transcontinental & Western Air, and Paul Collins of Boston-Maine are among air line presidents who have attended these sessions, the first mentioned having attended two of the meetings. Operations heads, including Ralph Damon, Messrs. Synder and Richardson of PAA and Jimmy James of Western Air, have attended sessions, the last mentioned acting as chairman in Chicago in 1934 in place of Walt Hamil-

ton who was busy accepting delivery of DC2's at the time.

Dr. George W. Lewis of the N.A.C.A. and Dr. Jerome Hunsaker of M.I.T. have also attended, the former on several occasions and, when he cannot be present, he sends a representative from the laboratories at Langley Field. Jerome Lederer of Aero Insurance Underwriters is always a welcome auditor and has contributed in a worthwhile way, especially in passing on data to fixed base and private fliers. Colonel Harold Hartney of the Senate Safety Committee and now of the C.A.A. has attended regularly and at the Miami meeting of January 1936 prevailed upon the late Senator Copeland to talk to the meeting. On such occasions the manufacturers are always invited to sit in and listen. Colonel E. S. Gorrell, President of the Air Transport Association of America, interpreted the Civil Aeronautics Act for all those attending the Chicago meeting in July of 1938.

The technicological phases of the business with which this committee concerns itself progresses very rapidly. And the methods of conducting the meetings have changed as they properly should. Some of the manufacturers of airplanes believe they should sit in at all times and that by so doing they and the air lines would benefit. This idea undoubtedly has considerable merit and a vote will be taken on this point by committee members before the next meeting.

The committee has certainly benefited by having Honorary Committee Member J. E. Sullivan and various officers of the Bureau of Aeronautics of the Navy Department, including Lt. G. T. Mundorff and his successor in charge of Naval aircraft maintenance, participate in its work as it has by having Captain Bill Irvine and Lt. Ed. Perrin of Wright Field at hand. Possibly having engineers of Boeing, Douglas, Lockheed, Curtiss-Wright, Martin and others sit in at all times when troubles are being discussed would be helpful to all concerned.

A little history of the conferences and how they grew like the proverbial pal of little Eva may be of interest. They began in 1931 as strictly for air lines and no one else. At the Atlanta meeting in 1933, when the writer was first associated with the committee, I noticed that numerous manufacturers' representatives congregated at the hotel where the meeting was held. They were left out in the cold and did not even have an ante room provided for them. It didn't dawn on me that they minded this, for it was "strictly air line" and if, during the course of the conference, they wanted to take a chance on selling some of their customers, it was okay with the customers.

At the Chicago meeting six months later even more manufacturers showed up. One sat down in the conference room and to his embarrassment and mine had to be "asked" out.

Since the Aeronautical Chamber of Commerce of America represented both manufacturers and air lines and since the manufacturers were, in their opinion, being treated rather shoddily, the committee authorized me for the Brownsville meeting in January of 1935 to advise manufacturers they would definitely be invited in before the conference to "say their pieces" but that sales argument and sales presentation would be strictly taboo. Since and including the Hollywood meeting of 1937 the conferences have been conducted under the auspices of the Air Transport Association.

This worked extremely well. Mr. Erwin Balluder, head of the western division of Pan American attended the entire session, and commented very favorably on the manner in which the conference was conducted. Jack Bunce of Pratt and Whitney was especially helpful at that meeting in straightening out the boys in their handling of Wasps—extensively used at that time in Fords and other ships. Bill Kennedy, as usual, acquitted himself admirably. In fact he and Ken Boedecker had become so enthusiastic about these meetings that they sold Arthur Nutt, chief engineer of their company, on attending the meetings; Art hasn't missed one in recent years. It was at Brownsville that a meeting room was first provided for manufacturers.

A typical session was that of the

Detroit conference of July 1935 which conference was attended by twenty air line men representing fourteen air lines, including the Dutch KLM, six representatives of the Bureau of Air Commerce, four officers and civilian engineers from Wright Field, two men from the Naval Bureau of Aeronautics and forty-three representatives of manufacturers. Major R. W. Schroe-

(*Turn to page* 88)

Check AND DOUBLE CHECK

The exacting requirements met by manufacturers in building Air Corps machines are matched by methods of maintenance in service. The author has had long experience in maintenance work in the Army. He is an Honorary Member of the Maintenance Committee.

By Captain Clarence S. Irvine

Air Corps, U. S. Army

THE LAST TEN YEARS have brought far reaching changes in the equipment of the Air Corps. The positive trend toward the use of all-metal low wing monoplanes of high performance has included both tactical and advanced training types and has resulted in a drastic modernization of maintenance procedure and policies.

The use of highly supercharged engines for pursuit and bombardment, and moderate supercharging for the majority of other types has intensified the problems of engine maintenance.

The emphasis on performance and all-weather flying has resulted in the installation of a bewildering array of highly complicated accessory equipment. Blind flying and landing instruments; retracting landing gears; wing flaps; constant speed and full feathering propellers; automatic power and mixture controls; these and many other items, all add to the magnitude and scope of the problem.

The day is gone of the good old-fashioned crewchief, jack of all trades —who proudly boasted that he knew the health and strength of every stitch in the linen, and every glued joint in the plywood of the wing spars.

The high and exacting standards of maintenance and inspection required in our present day Air Corps, coupled with the fact that the art of aviation now embraces almost every phase of engineering, has forced the issue. The day has come of specialized training, and concentration on sharply defined fields of endeavor. In our technical schools at Rantoul and Denver, thorough training is given in electricity, mechanics, hydraulics, aerodynamics, internal combustion engines, communication and armament. While the theoretical phases are covered in sufficient detail to give a good basic understanding, the emphasis is placed on practical application to the care of airplanes and equipment in the field.

Structural repairs on airplanes in the past were mainly performed by a woodworker with his glue pot, and a fabric worker with his scissors and dope-brush. Now a sheet metal worker with a bucking bar, a pair of tin snips and a handful of heat-treated rivets holds the center of the stage when repairs are needed.

Now for a brief outline of the organization and managerial control back of the men who groom our fighting ships.

To the Field Service Section of the Materiel Division at Wright Field has been delegated the responsibility for the administrative and technical control of storage, issue, overhaul and maintenance of Air Corps equipment. The basis of technical instruction and direction is the Technical Order system. Separate technical orders are issued for each series of type of airplane, engine, or item of accessory or auxiliary equipment. These T.O.'s are divided into sections pertaining to flight operation, field maintenance and inspection, depot overhaul, and parts lists. They are issued in loose leaf form for convenient revision.

The actual storage and issue of supplies, and the overhaul and repair of equipment, has been decentralized to four major continental air depots, and three insular air depots. In order to limit the investment in stocks, and prevent obsolescence, only sufficient supplies for short periods are carried in the warehouses at operating stations and air bases.

In view of the expensive facilities

NOTE—The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Air Corps or the Military Service at large.

both in structure and equipment, as well as the trained overhaul personnel necessary for the performance of major overhaul activities, Air Corps policy has tended to sharply limit work done in the field to only primary inspection and maintenance.

The tendency has increased in recent years, to anticipate need for overhaul by careful inspection, and to fly the complete airplane to an Air Depot whenever extensive overhaul or replacement is necessary. Experience has shown that the procedure as practiced in the past, when airplanes were completely dismantled and disassembled for overhaul, is no longer necessary or desirable on all-metal airplanes.

The period between major overhauls has been greatly increased. In fact, some criticism has been heard to the effect that our airplanes are so well built and maintained, that their useful life will be over ten years. This for tactical types, means that they will still be flyable long after performance of more modern types have made them tactically obsolete. However, they may still be used for training purposes to the limit of their economical operating life.

A far flung air transport system now connects the air depots with the larger air bases and stations, and permits close support of extended tactical operations away from home stations. Air express service is thus available for the transportation of maintenance supplies to the field, and the quick return of unserviceable equipment to the air depots.

The Visual Inspection System is the backbone of Air Corps maintenance in the field. This system not only provides a constant check upon the operating condition of each aircraft, but also provides a guide to insure adequate maintenance at proper intervals. It greatly simplifies the thorough training of mechanics, and affords supervisory personnel a quick and convenient check upon maintenance efficiency.

A small booklet is carried in each aircraft, in which appropriate notations are made by flight and maintenance personnel.

Complete records are kept by the crewchief of each aircraft, including: flight data; servicing, inspection and maintenance operations; and changes in or replacement of items of auxiliary or accessory equipment. These records are kept in such form as to be readily available for check or inspection by supervisory engineering personnel.

The primary responsibility for the determination of the adequacy of maintenance, and the operating condition of each aircraft rests with the squadron or unit thereof to which the airplane is assigned. Inspection and maintenance functions are performed at routine periods known as the Preflight, Daily, 20 Hour, Weekly or Special, and Engine Change.

Prior to the first flight each day, each airplane is given a Preflight inspection and engine warmup. At this time a thorough check is made of engine operation; fuel, oil and cooling systems; engine and airplane controls; engine and flight instruments; servicing of fuel and oil; security of fuel and oil caps, doors, enclosures, etc.

The Daily Inspection is a visual inspection to determine the general condition of the airplane. It is intended to detect aggravated conditions, maladjustments, etc., which may tend to interfere with flight reliability, but is not intended to be sufficiently thorough to detect slight wear or minor discrepancies.

The 20 Hour Inspection, which includes the Daily Inspection, is designed to be thorough and searching. All parts are inspected to assure that they are in good condition and functioning properly, and that routine maintenance operations have been performed. This inspection is accomplished during normal working hours, and without withdrawing the airplane from regular service.

The 40 Hour Inspection includes the Daily and 20 Hour Inspection and is designed to be a very thorough, complete and searching inspection of the entire airplane. It need not be performed as a continuous operation, a reasonable time being allowed, in order to avoid limiting flight operations insofar as possible. At this period or multiples thereof, entensive maintenance operations are performed. For example, engine valve clearances are checked; spark plugs are removed for check and reconditioning; operation and mechanism of retracting landing gears are checked; propellers checked for balance, track and galling of cones; engine cylinder holddown nuts and engine mounting bolts checked for security; engine and airplane control systems lubricated and checked for wear or excessive lost motion.

Weekly and Special Inspections are set up to take care of cases that do not properly come under the hourly periods. In case of chronic malfunctioning of some item, special inspections may be set up, in connection with the determination of the cause and the solution thereof.

The Engine Change Inspection is made at the time the engine (or one of the engines in a multi-engined airplane) is changed. The expected period of operation in hours for each type and model of engine is covered by special instructions applicable to that particular engine. In case failures are experienced, or serious conditions are found at overhaul, the period may be reduced. On the contrary, freedom from difficulty, and successful operation of a test number of engines over a longer period, is used to justify extending the running time before overhaul.

At the time of engine change it is customary to replace or recondition the major items of accessory equipment such as generators, vacuum pumps, and starters. Instruments are thoroughly checked, and reconditioned or replaced if necessary. The entire airplane structure is completely gone over and much work accomplished that in past years would be considered as a minor overhaul. This procedure has been necessitated by the fact that present day airplanes can operate satisfactorily for extended periods between depot overhauls.

In order to obtain a completely unbiased and unprejudiced technical inspection of methods, procedures and systems employed throughout the Air Corps, the Chief of Air Corps relies upon the Inspection Section of his office. This Section is charged with:

Parachute maintenance is an important part of the Army's problem.

The development of systems for increasing the standard of maintenance of Air Corps equipment and installations; the assurance that all flying equipment is maintained in a serviceable and airworthy condition; that only authorized changes are made in equipment, and that these changes are made at the time and in the manner prescribed; that records, reports and files are properly prepared and maintained; in summation, that all administrative and technical instructions are fully and properly complied with.

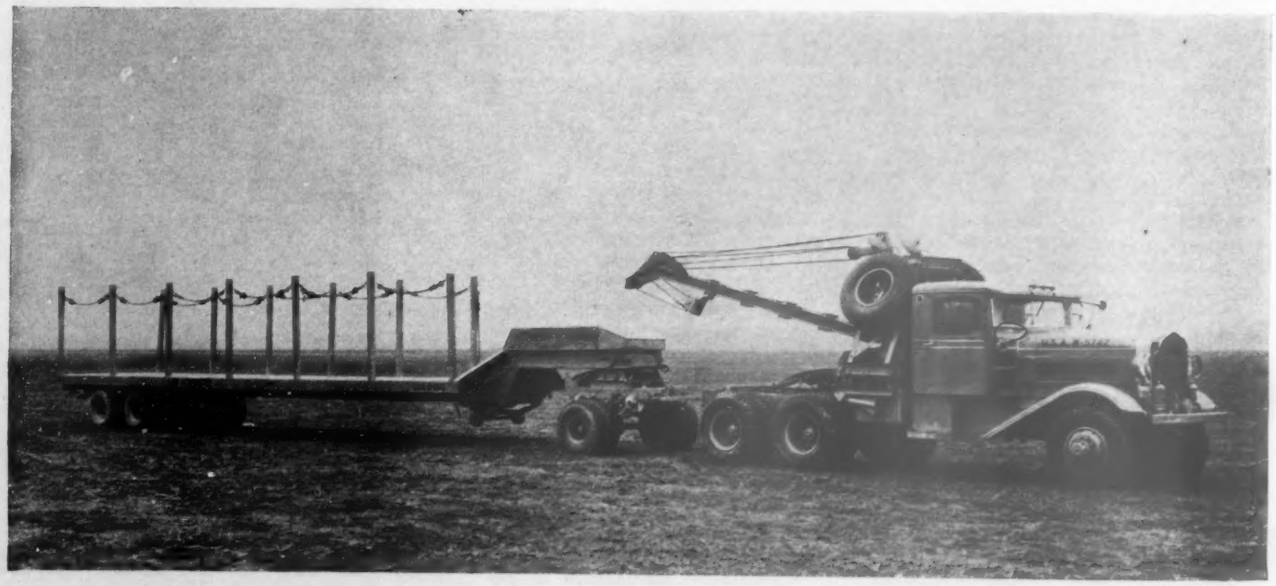
In order to facilitate the carrying out of technical inspections, control has been decentralized to each Air Depot Control Area. In each such area, operating directly under the Inspection Section, O.A.A.C., are officers known as "Technical Supervisors." In addition to technical inspection and supervision of activities within their areas, they are also responsible for coordination and liaison between field activities and the Air Depot of all matters pertaining to the technical condition of equipment, the desirability of overhaul and related matters.

In an organization utilizing the tremendous assortment and variety of equipment necessary to the fulfillment of the Air Corps mission, failures and malfunctioning inevitably occur. In order to properly classify and record data pertaining thereto, facilitate correction of undesirable conditions, and utilize to the maximum the experience gained in the design and procurement of new equipment, a procedure was devised covering reports by the service on each case of malfunctioning.

According to present procedure, a report is prepared by the using organization whenever an airplane, engine or item of accessory or auxiliary equipment fails in service, or fails to reasonably perform its proper function for the period contemplated by technical instructions. These reports are forwarded, together with sample damaged parts or photographs thereof, through the engineering echelons of command to the Field Service Section, where the reports are classified, recorded and filed. Appropriate comments regarding seriousness of the problem, and action recommended are appended by the supervisory engineering offices through which the report is forwarded.

In the event that information is available in the Field Service Section regarding necessary corrections or action deemed desirable, an immediate radio or letter reply is displatched to the originating unit. In case material on which to base a reply is not available, the report, together with all data and records pertaining thereto go to the Experimental Engineering Section for study and recommendations.

Monthly technical inspection by Technical Supervisors and Post Staff, Randolph Field, Texas.



Type C-2 wrecking truck and trailer. Overall length, 74 ft. Loading platform, 8 ft. x 40 ft. Capacity of trailer, 25,000 lb.

Regular 20 hour inspection and maintenance check on a Northrop A-17-A attack plane of the Third Pursuit Group.

Engineering personnel then engage in such research and test procedure as is required to obtain a solution to the service difficulty. If the problem is sufficiently serious, the manufacturers engineers, and in some cases, other governmental research organizations, are called into consultation. After the solution is attained, the same procedure is followed as in the case of all other technical instructions. That is, the Air Corps engineers specializing in that particular phase of aeronautical research, prepare the data for instructions to the service. These instructions are then issued by the Field Service Section together with drawings as required, and distributed to the field and air depot activities.

These reports from the service have been found to be of great value, not only in the fulfillment of their primary mission of keeping service equipment in satisfactory condition, but also in the design and construction of similar items. Past maintenance records are always consulted during the evaluation of complete airplanes submitted for procurement. Every effort is made to eliminate features in new designs of aircraft or accessories that reports have indicated to be unsatisfactory in service operation.

One of the most difficult problems confronting maintenance personnel is the handling of airplanes which have suffered forced landings. To care for this problem, the Mobile Repair Unit has been developed. This Unit is intended to be primarily a Depot tool whose function is the repair of damaged aircraft in the field at some distance from depots or air bases. The Unit consists of selected personnel, provided with the Type C-2 wrecking truck, supplemented with special tools, machinery and transportation as required by the particular emergency.

During the early part of each year Cold Weather Tests are conducted at northern bases. Experimental and Service Test Equipment, particularly of maintenance character, is thus given thorough and exacting tests under the most rigorous of field conditions. As a result of these tests special accessories and equipment have been developed that will permit aircraft operation under any climatic condition. Aircraft engine oil dilution; field working enclosures; special adjustable mechanics work stands and ladders; hydraulic jacks of large capacity; special snow removing equipment; portable-by-air electric power plants, and many other essential items have been developed, tested and proven as a result of these and other field exercises.

It is the proud boast of the Army Air Corps, that it, like the Navy, is a "Fleet In Being" ready for effective field operation at any hour, in any direction, under any conditions of climate, weather or operating terrain.

Type F-1 refueling unit developed for the Army Air Corps. Capacity 4000 gal., 40 to 400 gal. per min.

Servicing OUR FLYING FLEETS

Good maintenance is the essence of safe operation on the long over-water flights that are routine for Naval air missions. The author is now in charge of aircraft maintenance in the Bureau of Aeronautics.

By Commander Felix B. Stump, U. S. N.

Head of the Maintenance Division Bureau of Aeronautics

THE MAINTENANCE of naval aircraft has undergone very rapid changes in a comparatively short time. The transition from wood to metal came about almost over night, and a generation of skilled woodworkers passed from the scene or shifted into the metals trades. There is a serious shortage even today of skilled personnel in the art of forming and fastening metals. From a maintenance standpoint, there are many advantages to wood and fabric and wire construction, and it has been said that minor repairs to the older types could be effected with hardly more than a needle and thread and a piece of cigar box. Modern aircraft require a can opener in many instances even for inspections.

NOTE—The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

The power of the fleet depends upon the efficiency of its bases, upon its shore facilities, without which it cannot operate. Our fleet, however, to a greater extent than that of any other great nation, must be sufficiently self-sustaining to operate for months far away from its essential shore establishments. And naval aviation, a vital part of the fleet, must maintain its efficiency far away from its bases by the efforts of its combat squadron personnel, officers and enlisted men, to a greater extent that any other air force.

In order to provide such trained personnel, our overhaul shops are manned by ⅓ enlisted men and ⅔ civilians in continental United States, with a greater proportion of sailors at outlying bases in the Canal Zone and Hawaii. The backbone of squadron maintenance consists of the officers and enlisted men who have had their tour of duty in overhaul shops ashore. There they have learned to be expert engine mechanics, metal workers, instrument and ordnance men. They must constantly perform work within the facilities of their own squadrons, which, in other air forces, would be done at the repair bases.

Aviation in all its phases is progressing so rapidly that it is impossible to visit a well managed aviation repair base, army, navy, or commercial, without finding some equipment (often built locally), some process or procedure, some method of inspection or test, or some shop arrangement different from and superior to all others. Recognizing this, with great benefits in economy, efficiency and quality and with the cooperation of the army and the airlines, the navy endeavors each year to have one or more of the leading personnel of each of our overhaul bases make a tour, generally in a group, of the larger army, navy and commercial overhaul bases in continental United States. At the comple-

tion of the tour, the personnel making it assemble in the Navy Department for two or three days for a general discussion and interchange of notes and ideas, in which various specialists and maintenance personnel on duty in the Bureau of Aeronautics participate. A complete report of the tour and discussions is then mailed to all units which would be benefited therefrom.

Naval aircraft will be found from the Mediterranean Sea to the China Coast and from Panama to Alaska. Spare parts must be duplicated when not too costly or arrangements must be provided for quick distribution from a central agency. The multitude of articles necessary for the maintenance of fleet aircraft is magnified by the divergency of types as well as the geographical separation of the points where the material is required.

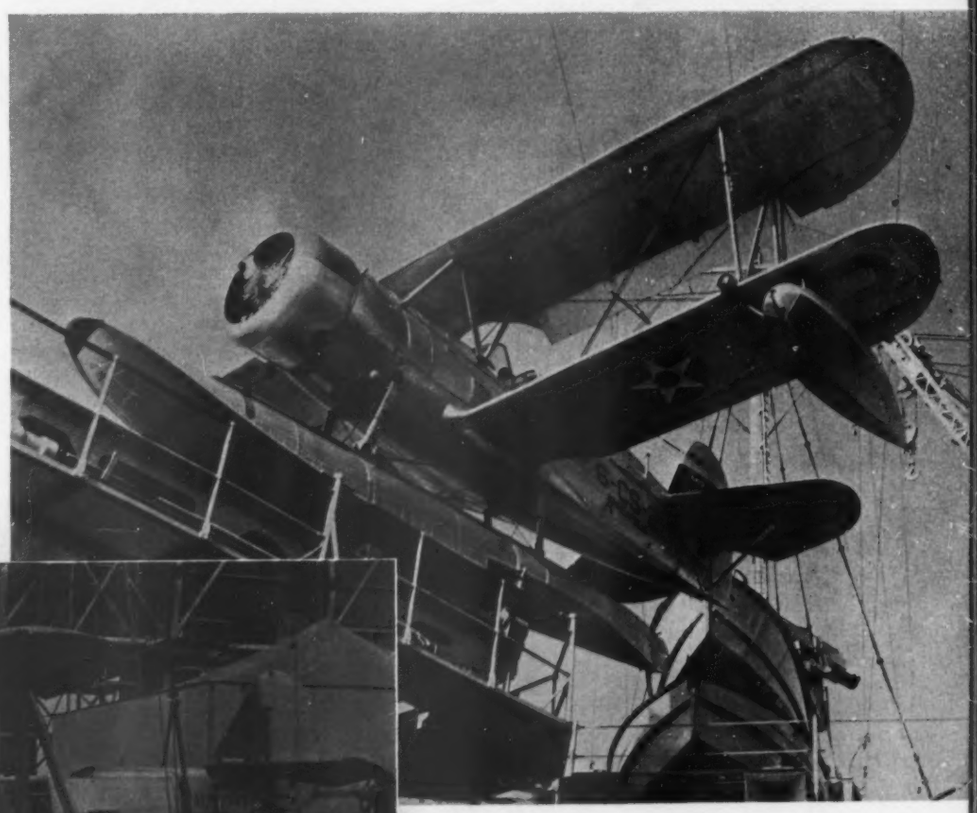
Storage problems for perishable material are acute in the tropics and the available space aboard the aircraft carriers and other surface craft is a matter of serious moment.

The obsolescence of naval aircraft requires a very neat balance between the program for manufacture of spare parts and the number of such items that will be required prior to the time when the last planes of a certain model are scrapped. Of course, any spares remaining at that time are a total loss and for this reason it is difficult for the purchasing agencies to resist a policy of hand to mouth buying for a model near the end of its useful life. Nevertheless, the tooling and manufacturing costs for small quantities is terrific and it may readily be seen that a few intricate spare parts in excess, after all planes of the model using them have been scrapped, might economically be charged to insurance against the possibility of manufacturing in small quantity at tremendous money cost and equally costly delay.

Standardization is of extreme importance in maintenance, primarily in insuring interchangeability between various parts on various types of airplanes at different maintenance bases. Army-Navy standardization in the past has been accomplished by agreements between the Army Air Corps and the Bureau of Aeronautics. This standardization involved primarily the establishment of records of technical agreements. Such agreements were not promulgated as such for procurement purposes. Under the Aeronautical Board there has been established recently a committee composed of representatives of the Chief of the Bureau of Aeronautics and the Chief of the Army Air Corps charged with coordinating the requirements of the two services to the extent that single joint documents will be issued and promulgated as such for procurement purposes by both services. This system is now in effect and doubtless will have a direct and beneficial bearing on maintenance. Incidentally, Army-Navy standardization is not only considered in terms of the needs of the Army and the Navy but consideration is given, prior to the adoption of these standards, to making them adaptable to commercial aeronautics as well.

Corrosion

A problem particular to the Navy, or possibly to the very few commercial lines which operate over salt water, is that of corrosion. Carrier planes on deck, and the cruiser and battleship planes, perched on their catapults are subjected to salt air, spray, funnel smoke, and sun and rain for months at a time. Flying boats may be anchored out in the water for weeks on end, possibly in the high humidity of Panama or the snows and fogs of Alaska.



Catapult work poses special maintenance and servicing problems. Left, Scout observation under overhaul at Norfolk.

In the past, not as much care in design as could be desired has been exercised to secure free drainage of

structures. This condition is improving, but, not only in manufacturing, but also in overhaul every possible step should be taken to insure that water or moisture which gains access to the interior of a structure is afforded free drainage so that it may not remain and induce corrosion.

Upon removal from salt water, a seaplane should be washed immediately with fresh water to remove all traces of silt. A light film of oil should be applied to the unpainted parts.

In the same way, design has not always provided for the separation of dissimilar metals and many of the defects found during overhaul can be laid to such errors. Frequently care must be exercised to remedy such mistakes so that corrosion will not develop prior to subsequent overhauls. When dissimilar metals must be used because of structural conditions, they must be insulated from each other in order to forestall electrolytic action and consequent corrosion.

The greatest care in following approved specifications for the heat treating of aluminum alloys is important for strength considerations but is even more vital as a means of resisting corrosion. As an example, properly heat treated aluminum alloy 24ST has been in use in some of the later, larger patrol seaplanes for over a year's service under the most adverse conditions of contact with salt water and spray, with practically no corrosion—a surprisingly gratifying performance.

Barnacles

The growth of barnacles on the underwater surfaces of large seaplanes in the tropics constitutes a serious problem where facilities for readily removing the aircraft from the water are limited. Within a few days the growth of barnacles can become sufficient to prevent take-off without a great reduction in the normal load. Barnacles, some as large as $\frac{3}{8}$ in. in diameter, have completely covered the bottoms of airplanes moored ten days in unclean tropical water. The growth of barnacles occurs to a less, although still serious, degree in clean tropical water. The presence of both river silt and sewage appears favorable to barnacle growth.

Barnacles four days old can be removed with a stiff bristly brush. Those over ten days old become very firmly attached and require wire brushing and sometimes scraping with an aluminum scraper.

The barnacles penetrate through both bituminous paint and aluminum lacquer and attach themselves to the zinc chromate primer underneath. When bituminous paint was covered with "Par-al-ke-tone" there were fewer barnacles but the main advantage of the "Par-al-ke-tone" seemed to be that the barnacles formed were easier to remove.

The following coatings over the basic zinc chromate primer are listed in order of merit for the resistance to the formation of barnacles: "Silosyn," aluminum lacquer, black enamel mixed with bituminous paint, and bituminous paint. Of these, "Silosyn", an acrylate resin base product, gave by far the best results. It was the only one of the group which the barnacles did not penetrate and the amount formed was the least of the lot. Two coats can be sprayed on a large twin-engined seaplane hull in forty-five minutes.

The search for improved protective coatings in an effort to reduce maintenance difficulties has always been assigned high priority by the Bureau of Aeronautics and many developments initiated by the Navy have been passed on to commercial aviation. In particular, the magnesium anodic treatment, zinc chromate primer and a number of synthetic lacquers stand out as important contributions in recent years. The aluminum metal spray has been found very effective in preventing corrosion of steel as well as of aluminum alloy parts, and our standard overhaul practice makes use of this means of protecting engine cylinders in all cruiser and battleship based seaplanes where cleaning of the cylinders after they have been subjected to salt spray is difficult.

Engines

Three recent improvements in engine construction are resulting in more flight time between overhaul and upkeep periods.

The first improvement is the adoption of automatic valve gear lubrication. This has made possible the extension of the operating time between checks and readjustments of valve clearances from thirty hours to one hundred and twenty hours. Indications are that an even longer period may be adopted. Automatic valve gear lubrication reduces wear of the parts of the valve mechanism, particularly the exhaust valve stems and guides. It is no longer necessary to replace these parts on nearly every major overhaul, which was formerly necessary.

The second recent improvement is the adoption of nitriding as a means of hardening cylinder barrels. Service experience to date indicates that nitrided cylinders may last as long as the engine, thus eliminating regrinding, and, therefore, the need for much expensive equipment and skilled work. Thus, it may no longer be necessary to carry a stock of oversize pistons and rings or to rebarrel cylinders.

The third improvement in engine construction is the adoption of prefitted, lead coated silver master rod bearings, which can be installed immediately during overhaul without boring to size, thus eliminating the need for expensive boring equipment and skilled personnel to operate it.

Experience shows that corrosion of engine cylinders will start within twenty-four hours after stopping an engine which has been run on gasoline

Annual overhauls involve complete stripping of wings of huge patrol boats

doped with ethyl fluid. Such corrosion is negligible in the case of engines being run continually as on the airlines. However, when an engine is to be placed in an inoperative status it is necessary to supply it with fresh oil and run it on clear, unleaded gasoline for one hour to remove all traces of ethyl fluid from the cylinders and from the other parts of the engine.

Ignition cable deteriorates rapidly and for that reason overhauled engines do not have ignition cable installed until just before they are to be placed in service. It has been found beneficial to purchase ignition wire in sealed cases and not to open the containers until the wire is actually needed.

One of the most useful items in a modern engine overhaul shop, and in other shops as well, is magnaflux equipment for conducting magnetic analyses of steel parts. By means of it, many small cracks are found which would eventually lead to major failures and would be undetected otherwise.

The duration of the post overhaul test of engines is a source of concern to overhaul activities. A long test is expensive in fuel and labor costs and ties up facilities to too great an extent. A test which is too short will not wear the engine enough to insure reliable performance. The principal concern is to have a sufficient running-in period to seat piston rings properly. Post overhaul engine running may be reduced by lapping the piston rings in their respective cylinders and by using rings having a slight taper on the face, resulting in high unit pressure on the edge, which will cause them to seat quickly. Apparently, with the use of tapered rings a running-in period of four or five hours' duration should be sufficient to insure proper engine performance.

Instruments

It has been found impossible to hire trained instrument men, thus necessitating training of both civilian and enlisted personnel at the navy overhaul bases. It has been found that marked deterioration of instruments will occur in storage due to lubricant evaporation and gasket shrinkage. Therefore, it is often necessary to overhaul instruments that have never been used. Overhauled instruments are often more accurate than new ones, possibly because one man does the whole job. There is an urgent need for an instrument lubricant which will operate satisfactorily throughout the range of —40 deg. F. to +190 deg. F.

Maintenance and Research

Because of constant advancement in the art of aeronautics, it is many times not possible to obtain, on the first production order, airplanes one hundred per cent satisfactory in all details of design. Although Navy airplanes are subjected to a series of rigid and thorough tests prior to acceptance, experience has repeatedly shown that actual service operations usually bring to light the need for additional refinements. The need for such design changes obviously creates annoying maintenance problems. The discovery of the need for these changes calls for competent maintenance personnel. Further, the solution to the problems in many cases calls for extended research with the result that to a great extent maintenance and research are closely interrelated. For example, the need for a fire resisting doping system became very acute in the wake of several fires originating from sparks from ships funnels falling on airplanes while stowed on the decks of cruisers or battleships. These fires have been greatly minimized recently by the adoption of a fire resistant doping system for the upper surfaces of fabric wings of airplanes assigned to vessels of these types.

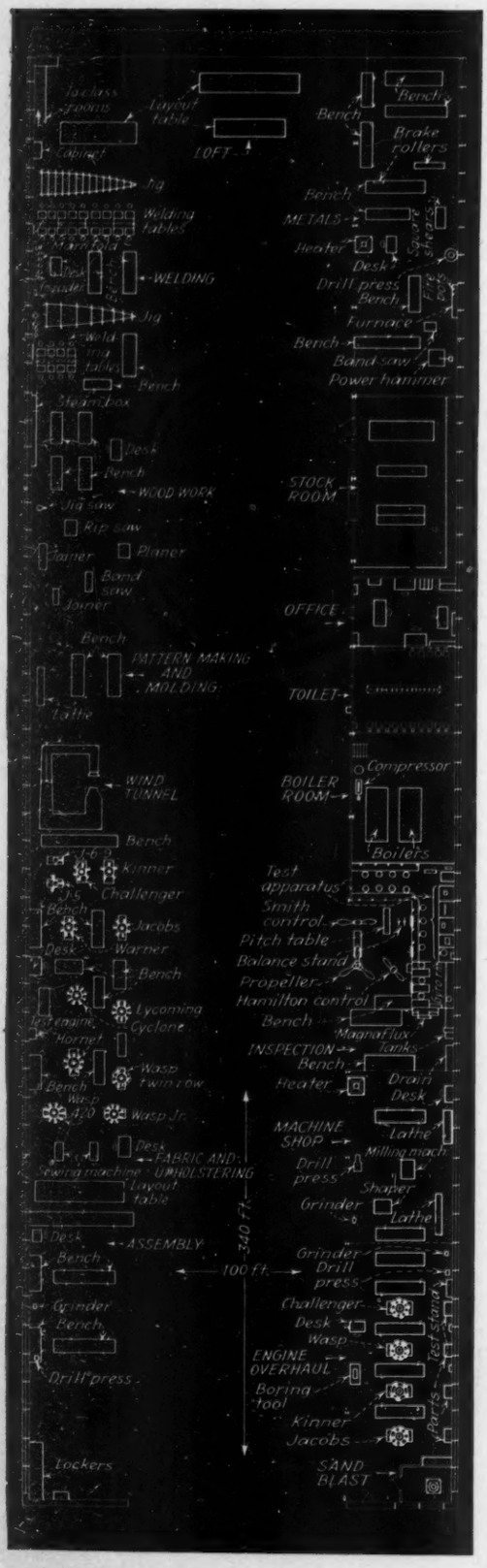
Carrier operations have also indicated the advisability of utilizing brakes which possess equal braking power in both directions. Such brakes have been developed and are now standard equipment on currently procured Navy airplanes.

The Navy has been one of the pioneers in the adoption of integral fuel tanks for flying boats. After airplanes in which such tanks were incorporated had been in service a short while, it was determined that a radical change in the conventional tank maintenance procedure must be effected to insure satisfactory service from them. It was found that the seam compound in these tanks was especially troublesome if not properly cared for in service and that they would leak if they were completely drained and allowed to stand empty for any length of time, due to the evaporation of the volatiles in the material. This was corrected by keeping the tanks filled with gasoline even when they were not installed in the airplanes as the action of the gasoline had a tendency to swell the seam material and prevent shrinkage of the material.

Corrosion of such tanks was also discovered early in their life. Although it appeared serious at first, the trouble has been practically eliminated by observing certain precautions in the handling of the fuel to insure that only clean, water-free fuel is pumped into them. The interior seams of integral tanks not in use are coated with a preservative to prevent shrinkage of the seam filler. The overhaul of integral tanks which did corrode called for considerable ingenuity on the part of maintenance personnel and in working out the solution an effective scheme for cleaning and anodically treating such tanks in place was developed. By following these and other precautions, it has been the Navy's experience that integral fuel tanks are highly satisfactory as used in its flying boat equipment.

Navy's excellent safety record is built around exacting care of engines and accessories.

MAINTENANCE *Training*



Aircraft maintenance has become an engineering problem of the first order. Here is the story of how one of our outstanding schools has set up and equipped a special course for maintenance engineers.

By William M. Thompson

Superintendent of the Maintenance Engineering School
Parks Air College

IN DEVELOPING and offering a course of training in maintenance it is essential that the many changes in the design and manufacture of transport airplanes be taken into consideration. In contrast to the bi-motor and tri-motor airplanes of the earlier days, with comparatively simple structures, there now are the Lockheed 14, Douglas DC-2s and DC-3s. Recently was launched the Douglas DC-4, of 65,000 lb. gross weight, with accommodations for 42 passengers, and a top speed of 240 m.p.h.; also the Boeing 314 Clippers that are being put into service on the Pan American Pacific and Atlantic routes, with a gross weight of 82,500 lb. and a passenger capacity of 74. More than this, it is reported that one of our leading aircraft manufacturers, the Consolidated Aircraft Corporation, has completed the preliminary study of an airplane of 400,000 pounds gross weight, with accommodations for 300 passengers and crew of 30, to fly at speeds in excess of 300 m.p.h.

With airplanes of this size, it is easy to visualize the complexity of mechanisms throughout the wings, fuselage, hulls and nacelles. These huge airliners, with auxiliary power plants and generators to furnish electricity throughout the ship and from four to six high powered, precision built engines, constant speed and hydromatic propellers, retractable landing gears, automatic power and mixture controls, hydraulic systems, robot pilots, radio apparatus, thremostatically controlled heating and ventilating systems, supercharged cabins, more than a hundred flight and engine instruments, over 12 miles of electrical wiring and more than a mile of control cable, to say nothing of the fuel systems and other accessories, every one of which must be kept in the highest mechanical state of repair to insure safe operation, will present maintenance problems which require more than mechanical skill for solution.

This rapid development of aircraft, coupled with a corresponding increase in passenger, mail and express traffic, presents a maintenance personnel problem of major importance to the operators.

We realize that keeping the transports groomed and in perfect mechanical order requires the services of men who are not only highly trained technicians, but also well grounded in basic principles involved. They need more than mechanical training. In short, with airlines investing more than $100,000 for a single transport

airplane, they must have men with an engineering background as well as exceptional mechanical ability. In order that a man may understand the complexity of mechanisms and so be able to properly maintain them, he must be well versed in many subjects other than mechanics, he must be able to reason things out and know why he is doing certain operations a particular way.

The maintenance problem is of such great importance that executives of large airlines anticipating delivery of these new planes shortly, have paid many visits to the college to inspect its facilities and to discuss with the faculty the training of maintenance personnel. One of these executives pretty well expressed the opinion of all when he declared: "We can get the airplanes built to our specifications but to get maintenance personnel who are dependable and qualified to service them is a major problem."

Members of our faculty in turn visited practically every airline base and every large aircraft manufacturer in the United States, holding conferences with maintenance and shop superintendents regarding their problems. Only after this careful groundwork did the college assume the task of providing training for the new field of Maintenance Engineering. It has been found that a course of no less than 96 weeks involving 34 classroom, shop and laboratory hours and approximately 15 hours of preparation each week, is necessary for a well-rounded training program for Maintenance Engineers. Seventy per cent of the student's time is spent in shops and laboratory, the remaining 30 per cent being devoted to classroom work.

In the Maintenance Engineering shops and laboratories is found equipment closely paralleling that of the larger airline maintenance bases. Included in this equipment is the very latest in radio, electrical and instrument repair and testing equipment, Magnaflux inspection machine, master- and link-rod boring fixtures, sheet metal working machinery, welding apparatus, woodworking machinery; machine shop equipment, including shaper, milling machine, grinder, drill presses and lathes. Our engine and propeller department includes steam cleaning tanks, sand blasting equipment, valve refacing tools, test stand for running in and trouble shooting, magneto test stand, propeller pitch tables, balancing stands, and controllable pitch propellers.

The accompanying drawing shows the location of departments and equipment included in the 100x340 foot main shops. Not shown are the 80x 100 foot dope and finishing room, the engine test stand, oakite cleaning building and classrooms used by the Maintenance Engineering School.

The matriculate comes to us as a graduate of an accredited high school. He comes because he has a definite objective, a career in the maintenance field of aviation. The early part of his training is devoted to the review of high school mathematics and physics, involving 60 hours of classroom work. During his first term (each of the 8 terms is 12 weeks long) the student is also given a course in engineering drawing, which includes free-hand sketching and making and interpreting engineer's drawings. His shop and laboratory work during this term provides 300 hours in advanced metals and applied metallurgy. In this period he acquires both a theoretical and working knowledge of all types of metals used in aircraft construction. The light aluminum alloys, their manipulation and heat treatment, are particularly emphasized. Loft practice is taught one hour each day, full size layouts of cowling, fuel tanks and other airplane parts being developed.

In the second term the student continues with 60 class hours in mathematics, physics and applied chemistry. The shop and laboratory instruction and practice involve intensive training in the theory of welding and the development of skill in welding tech-

nique through the actual welding of steel, aluminum, aluminum alloy, stainless steel, monel metal and other metals used in aircraft construction. He learns what metals are weldable and what metals are not. He studies the shrinkages, expansion and contraction of metals, jig building, the proper methods of aligning parts before being welded, and other related subjects.

His training in the ever growing long list of instruments and complicated electrical wiring systems is given particular attention and includes intensive study and actual laboratory work in the repair, overhaul and calibration of all flight and engine instruments, including gyro instruments and vacuum pumps. The wiring diagrams of the large transport airplanes are thoroughly studied from actual factory blueprints of these systems, with practical work in complete wiring and trouble shooting on modern airplanes.

Woodworking, patternmaking and molding, aircraft finishing and upholstering are included in his practical work in the third term. His classroom subjects include industrial engineering, maintenance management, also air transportation history and development, for it is believed the maintenance engineer should appreciate the larger problems faced by the management of the concern by which he is employed.

Airplane assembly and alignment, and airplane structures and maintenance, are studied both from a theoretical and practical viewpoint. The student is instructed in the salient features of airplane structures and maintenance and, through practical application, is given the opportunity of aligning and making necessary repairs on airplane structures. He studies controls, hydraulic systems and other features incorporated in our present day air transports. Radio maintenance and operation, involving the installation, repair and trouble shooting of radio apparatus, is carried through

four terms of one hour each day, a total of 240 hours. This is of particular value to the student who aspires later to become a flight engineer.

Power plant and accessory overhaul and maintenance come in for 840 hours of classroom and practical shop work. The student is given every opportunity to study the new developments in power plants and accessories. His practical work involves the actual overhaul of power plants, including all of the accessories pertaining thereto. During the time he is studying these subjects, he also secures one hour a day, three days each week, for three terms, in business writing, fundamentals of speech and salesmanship. These subjects are included in order to develop the student's ability to express himself clearly in writing and in speech, in conference and before a group.

Propellers, machine shop practice and flight line maintenance come in for a full term of instruction in both theory and practice. The fixed pitch, controllable, constant speed and hydromatic propeller principles are studied, and actual work is participated in by the student maintenance engineer in the shops. Machining of airplane and engine parts, tool and die making, and other machine problems are studied and practiced in the machine shop. Flight line maintenance involves daily periodic and complete inspections, engine checks and minor repairs on the fleet of 17 flight training planes. In order that he may understand the flight characteristics and have a better appreciation of the importance of his work, and the problems of the men who fly the airplanes, he is given 20 hours of flight instruction and one hour each day for 12 weeks he studies navigation and meteorology.

In the final term the student spends 2 hours a day for 12 weeks in the shop and drafting room, designing maintenance equipment. In this course he is given every opportunity to use his own initiative and develop his own ideas in designing equipment for more accurate and faster maintenance. The very important subject of inspection and safety in the concluding term incorporates the use of the magnaflux for inspection of engine and other steel parts, high powered magnifying glasses, cable testing devices, etc. Inspection reports are made out following complete inspection of parts and also of the entire airplane. Too much emphasis, it is believed, cannot be placed on this subject, as safety in the operation of aircraft depends to a large extent on proper inspection.

In order to round out his entire course the student is given training in Foremanship where he is put in charge of groups of men, with full responsibility for the solving of specific, practical maintenance problems. Besides serving to refresh the student on all practical work completed in the preceding seven terms, the period of Foremanship training serves to develop his ability to work with men.

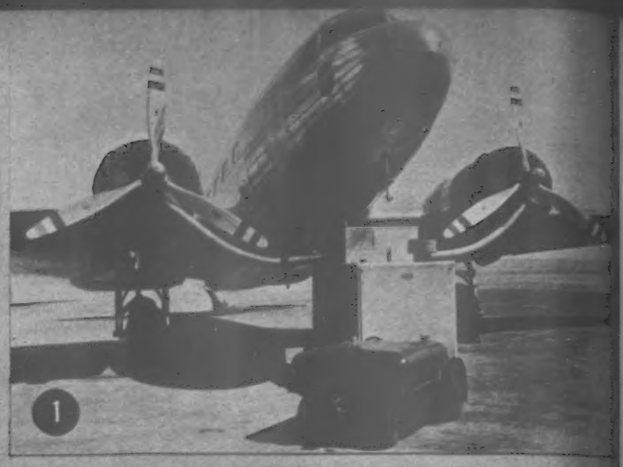
This program of maintenance engineering training, it is expected, will help solve a major maintenance problem by providing for the aviation industry dependable, well trained men who, with added experience in the operating field, will gradually be able to assume considerable responsibility.

AVIATION'S Maintenance Note Book

Although it is impossible to put into a reasonable space all the ideas that have been developed to promote safety through good maintenance, we present herewith a selection of shop gadgets and shop practices that seem to involve new and useful ideas. It is our hope that maintenance men in all branches of aviation work will find here something of interest, something helpful to them in carrying out their own jobs.

As a result of our inquiry for maintenance and overhaul pictures the shops responded to such an extent that we have many more pictures available in our files than we could possibly use in this issue. It is our intention, however, to continue the Maintenance Note Book through subsequent issues to put into circulation material that will be of benefit to operators of all classes of aircraft. Acknowledgment is hereby made to the air lines and to the military services for the excellent cooperation which was given us in the preparation of this issue.

APRON SERVICE JACKS, WHEELS, BRAKES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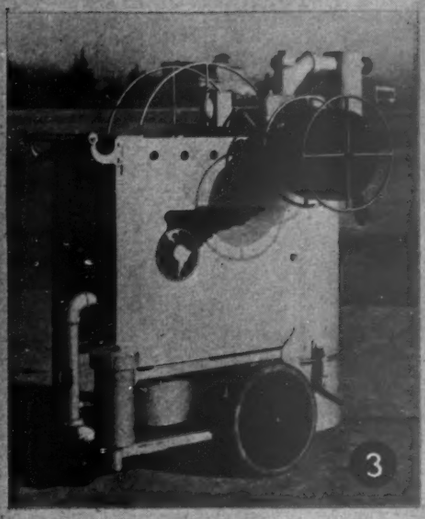
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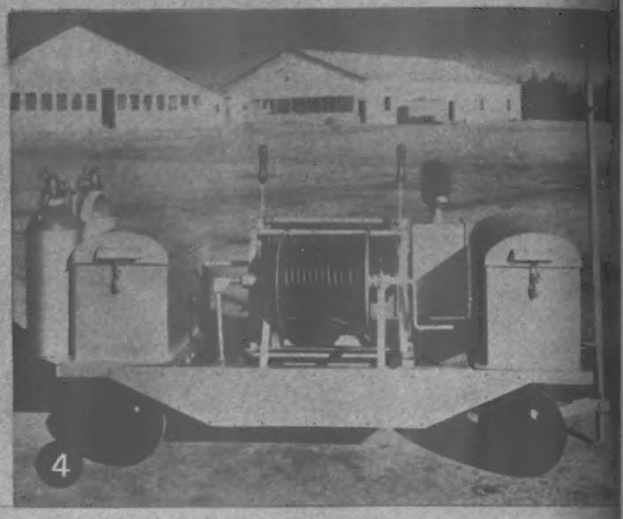
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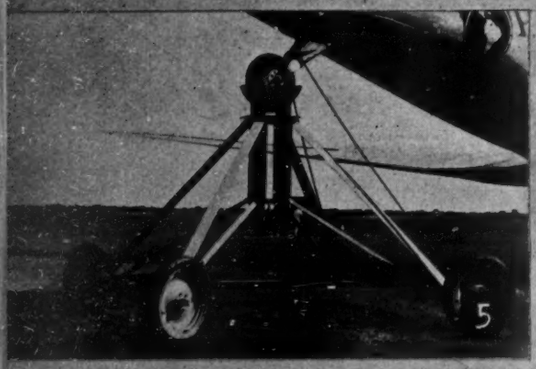
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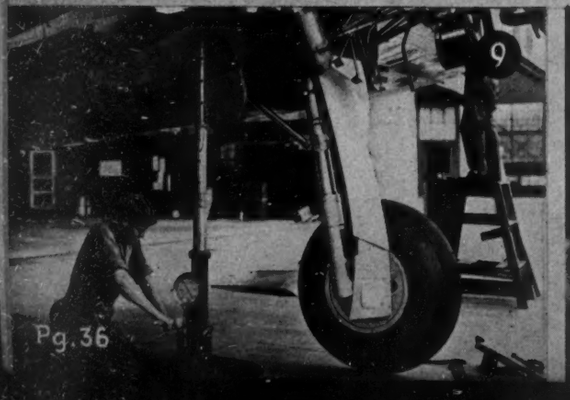
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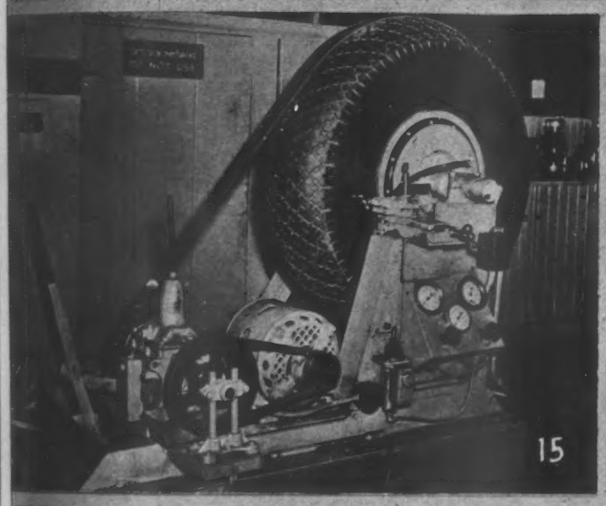

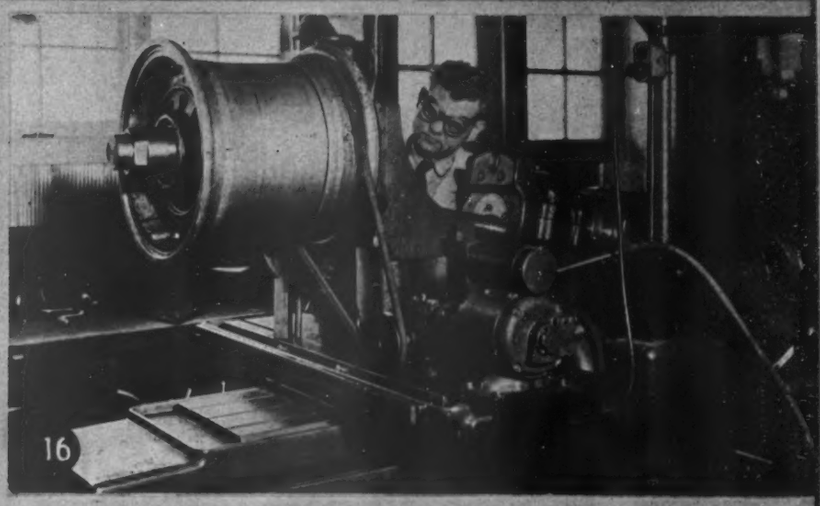

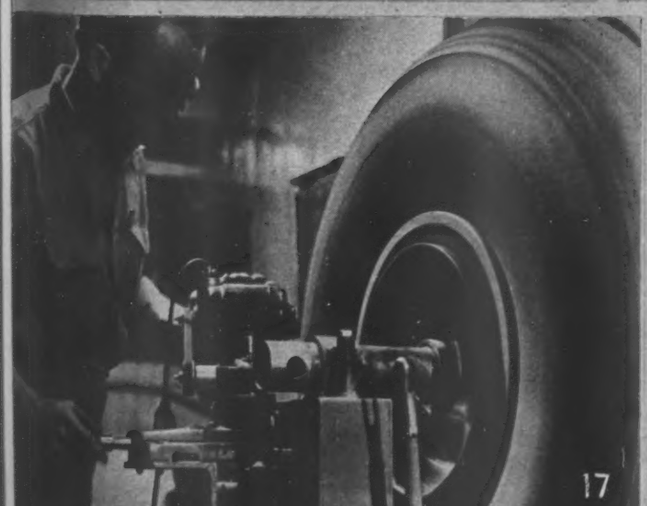

(1) Delco portable heating plant for pre-heating United's cabins and engines. It is handled by a special Baker electric tractor.

(2) PAA at Rio keeps this combination CO_2 bottle and Pyrenes on the beach to protect planes during starting and servicing.

(3) Commercial vacuum clean unit adapted for use at Alameda by mounting on cart. May be used as blower or for suction.

(4) Combination battery and Lux cart developed by PAA at Alameda. Handles operate battery switches. Light shows green when 12 volt circuit connected, red for 24 volts.

(5) For swinging compasses at Brownsville, PAA has developed this tail wheel rig. Tail wheel support is adjustable vertically.

(6) Braniff uses standard jacks to service Douglas undercarriages during overhaul. This picture is from the Dallas shop.

(7) Portable jacks developed by Aero Trades Co. for checking retractable undercarriages on twin-engined ships. Note tail stand.

(8) Northwest Airlines' jack stand for handling Lockheed 14s. The hydraulic jack units have been removed for service elsewhere.

(9) Hydraulic lifting and weighing jack used by Army on Curtiss Attack plane. Note broad base pad, also wheels for easy handling.

(10) Portable hydraulic jack unit used by Chicago & Southern in servicing Lockheed undercarriages. With undercarriage retracted, ship can be lowered to make nacelles easily accessible from floor.

(11) This TWA platform hooks over landing gear, permits easy working behind fire wall, and removes danger of slipping on the tire.

(12) EAL's special jig for assembly and testing the Douglas landing gears. After assembly, hydraulic jenny is attached and gear may be operated as under service conditions.

(13) Jig for disassembly of landing gear wheel and tire at EAL's Miami base. A 12-ton hydraulic jack furnishes the "push". Breaks tire away from both sides of rim in one operation.

(14) PAA's simple rig at Brownsville for changing big tires, a variation of the device shown in Fig. 12 above.

(16) Standard Heald cylinder grinder converted, by adding a special fixture, to handle grinding of brake drums on Douglas landing gears. UAL.

(15-17) By setting up wheel and tire in this special lathe, Braniff is able to machine and grind Douglas brake drums accurately.

(18) PAA's set-up for servicing amphibian gears at Miami. Note use of high-pressure Zerk gun. Also hydraulic test bench.

AIRPLANE OVERHAUL

(1) Upholstery repair and refinishing department, UAL, Cheyenne.

(2) Soundproofing and upholstery repair, PAA, Miami.

(3) Spencer turbine vacuum cleaners are used by United for rug and upholstery cleaning at Cheyenne.

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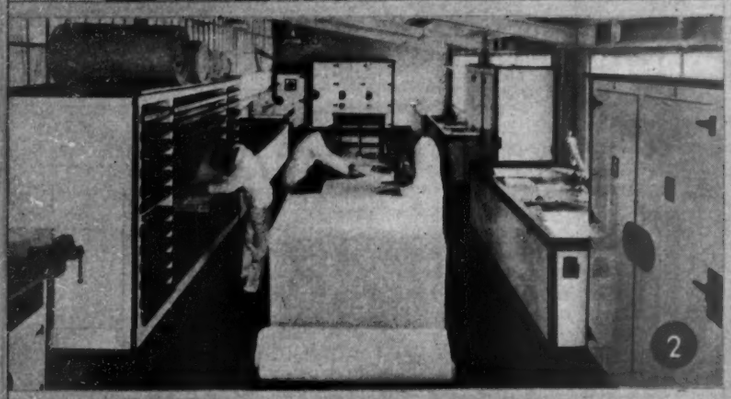
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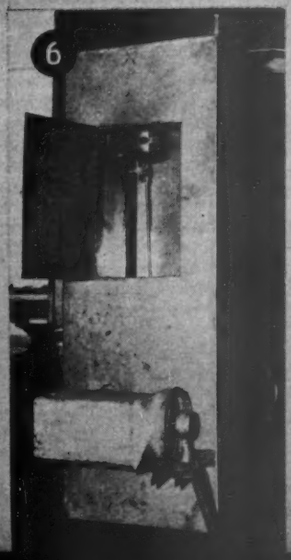
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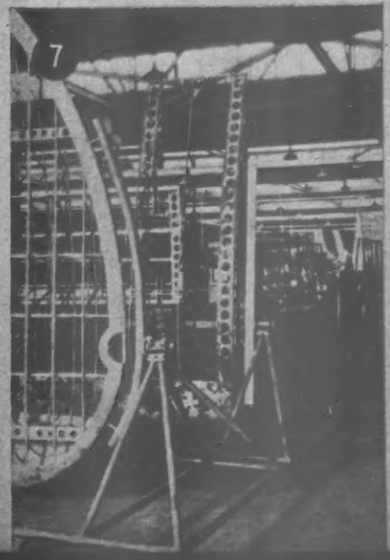
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(4) How United uses its Baker hoist to handle wing panels.

(5) American tests airplane heating system boilers and control valves on this set-up.

(6) Cabinet developed by Eastern for testing airplane heating and ventilating systems.

(7) Wing handling fixtures as used in U. S. Navy repair stations. Wing panels may be turned over.

(8) Squeeze riveter, PAA, Miami.

(9) Special hand vice used in assembling carburetor air scoop valve assembly.

(10) Gage used in transposing hole locations for accurate layout, sheet metal shop, PAA Chicago.

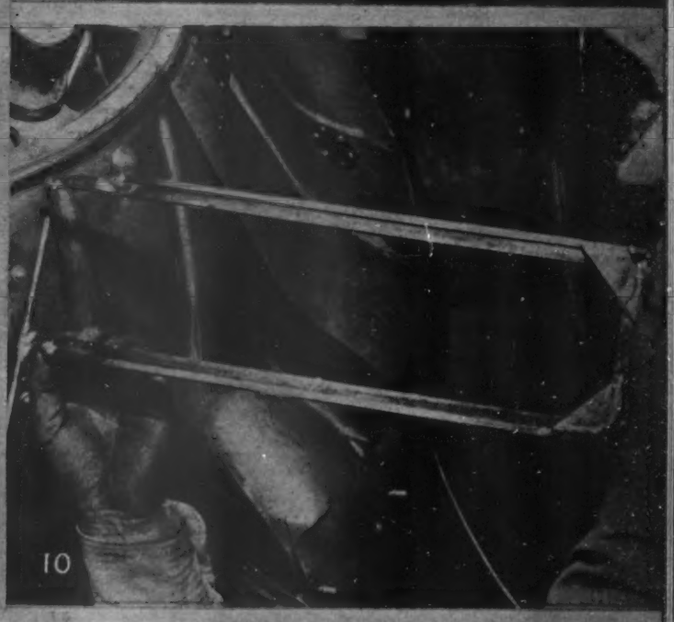
(11) United portable electric and compressed air outlets.

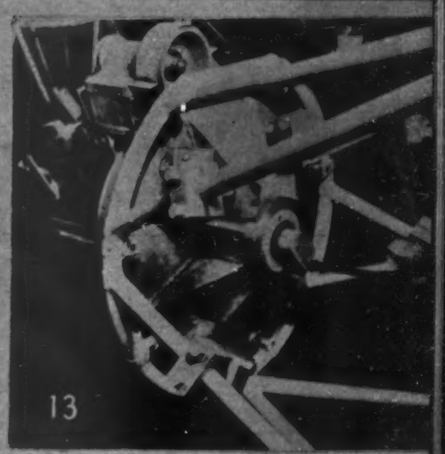
(12) Portable cable swedging bench and work stand as developed by Northwest Air Lines.

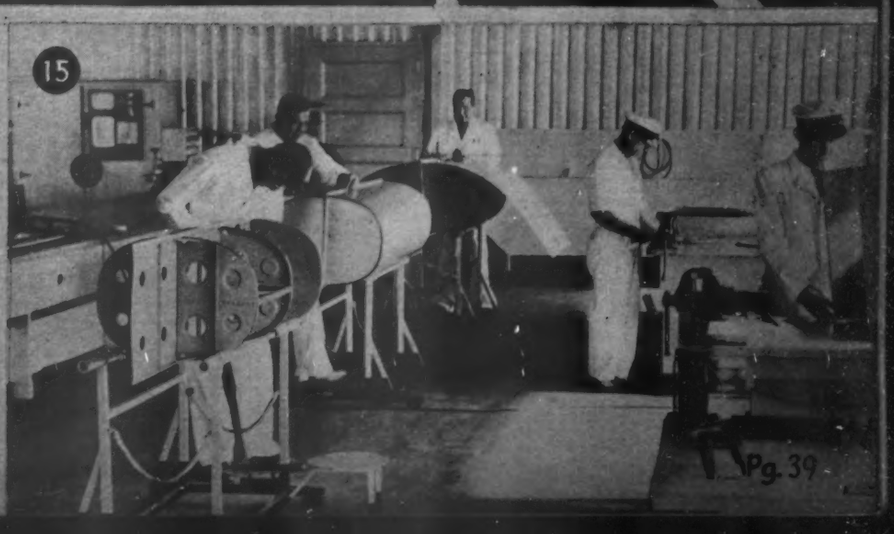
(13) Fixture developed by U. S. Navy to grind engine mounting lugs.

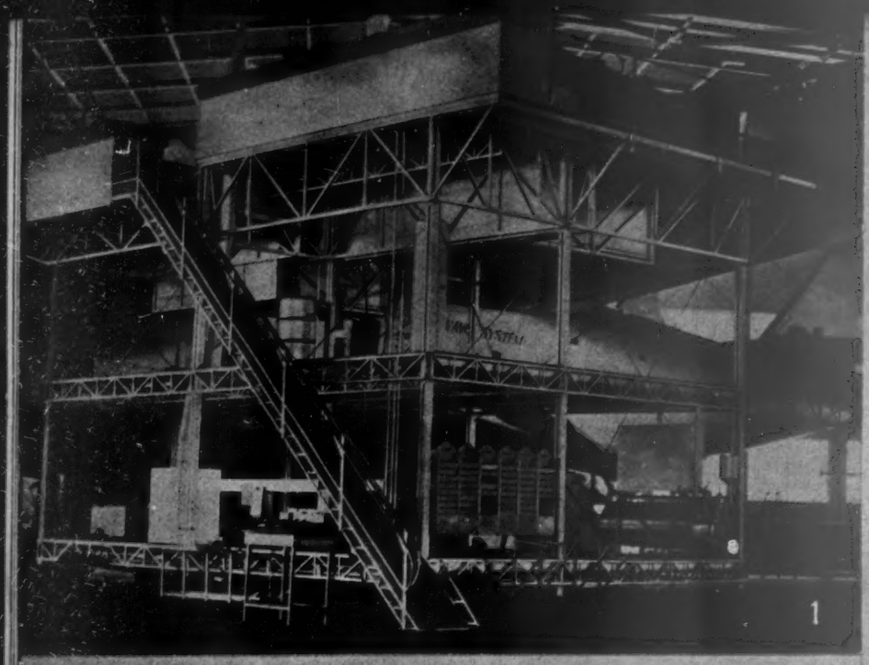
(14) A pair of 36-in. steel corrugating rollers takes care of United's corrugated sheet requirements for plane overhaul.

(15) A Pan American tank repair shop.

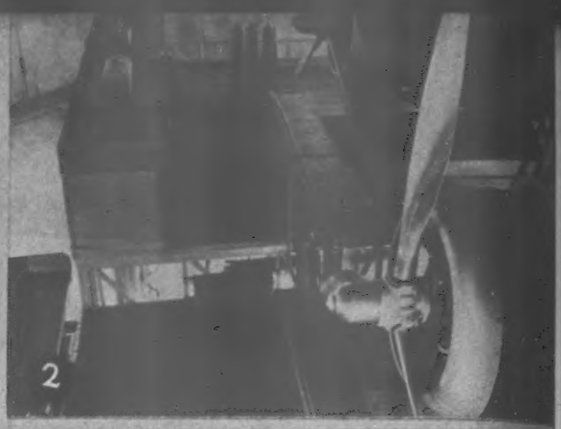


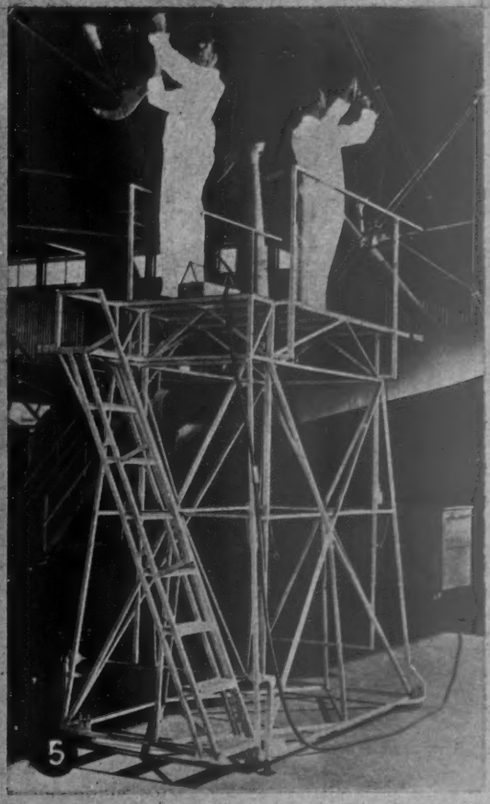


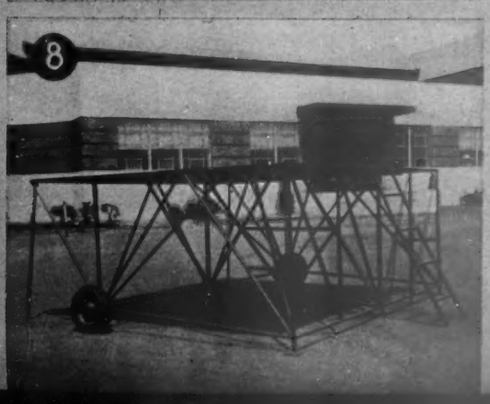


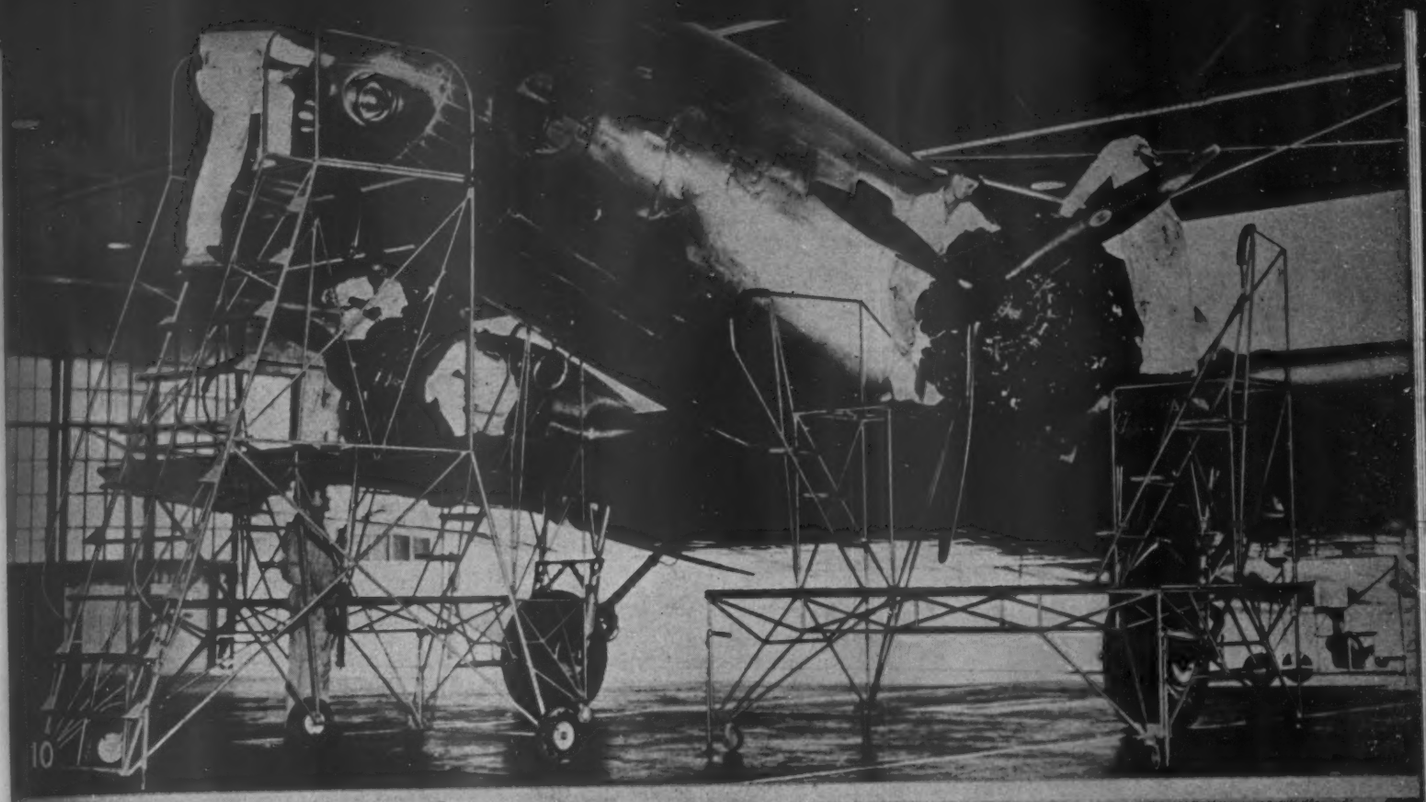


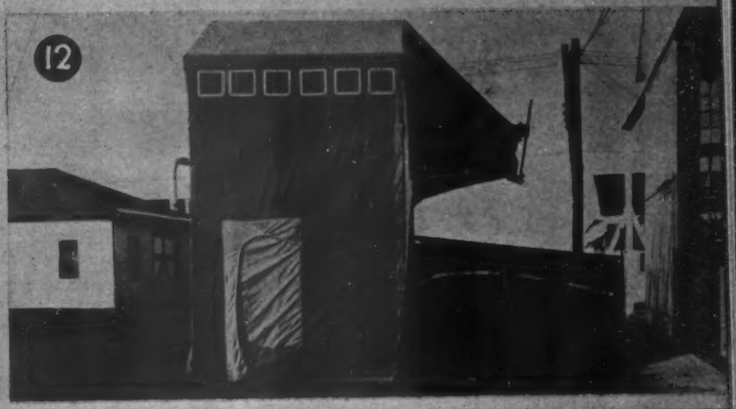
WORK STANDS

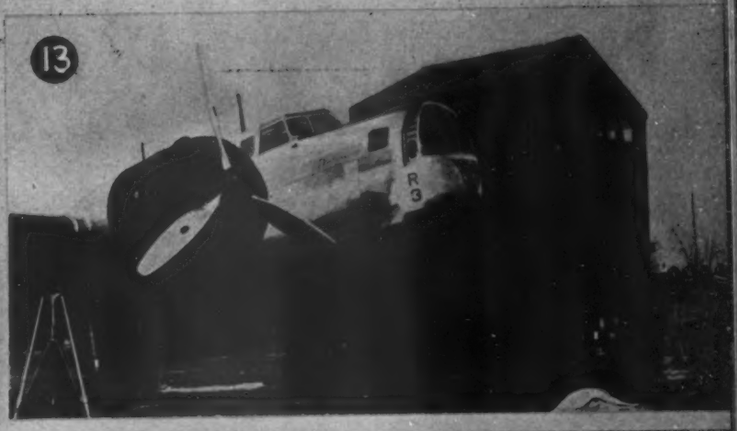


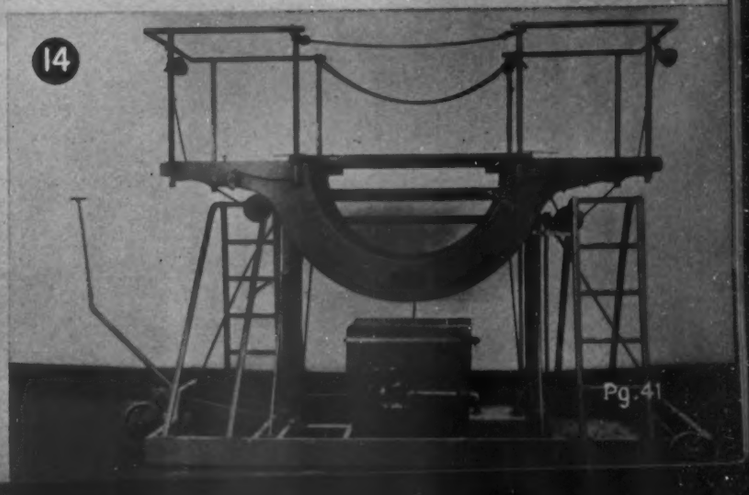












(1) Complete workshop on wheels. Just one-half of the work stand for the Atlantic type Boeing Clippers. PAA.

(2) Topside on the PAA work stand for the Boeing Clipper.

(3) Platform for servicing tail units. PAA Atlantic type Clipper.

(4) Ladder type stand in use at Miami base. PAA for S-42 tail servicing.

(5) For wing work on PAA'S S-42s. Miami.

(6) Brownsville (PAA) developed this type of stand for Douglas tail surfaces.

(7) United's version of a tail group servicing stand.

(8) TWA light engine servicing stand at Newark.

(9) TWA nose servicing stand, Kansas City.

(10) A group of well worked out servicing platforms in use in Braniff's Dallas shops.

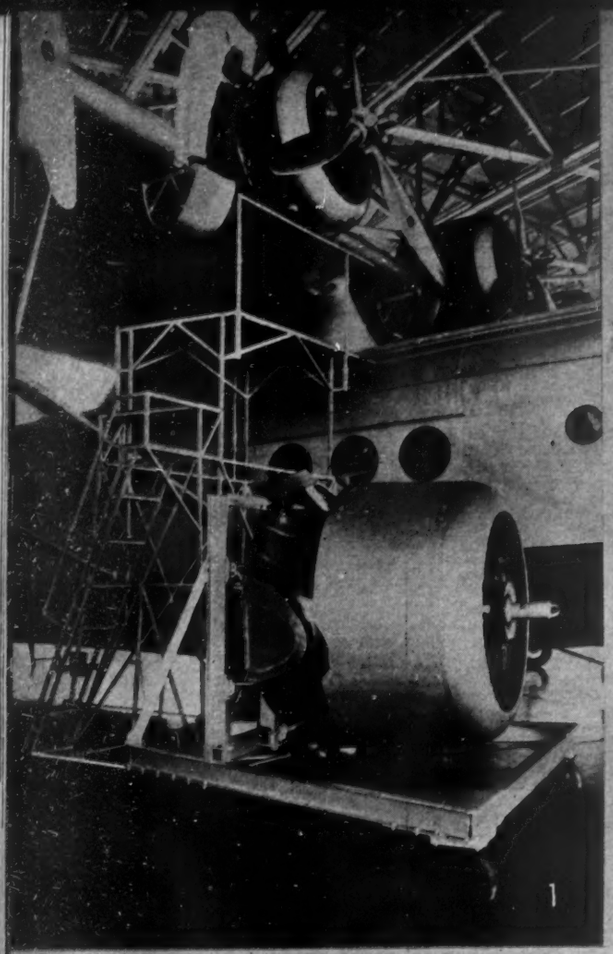
(11) Bridge-like scaffolding for fuselage cleaning. UAL.

(12) U.S. Army's field maintenance shelter for outdoor work in cold weather.

(13) Field maintenance shelter in place on Army B-18 Bomber.

(14) A portable hydraulic maintenance stand for large airplanes developed by the U.S. Army.

HANDLING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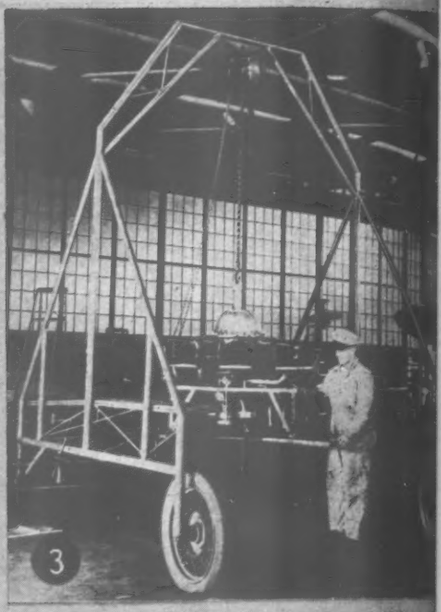
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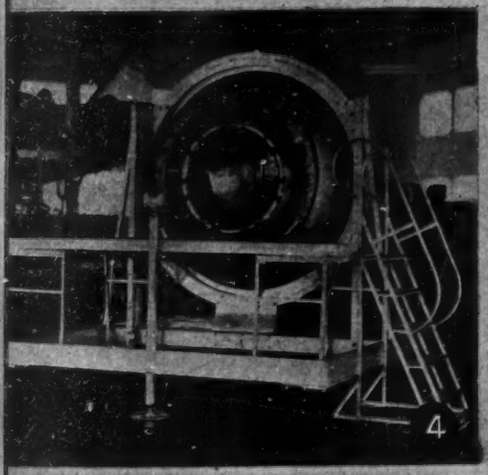
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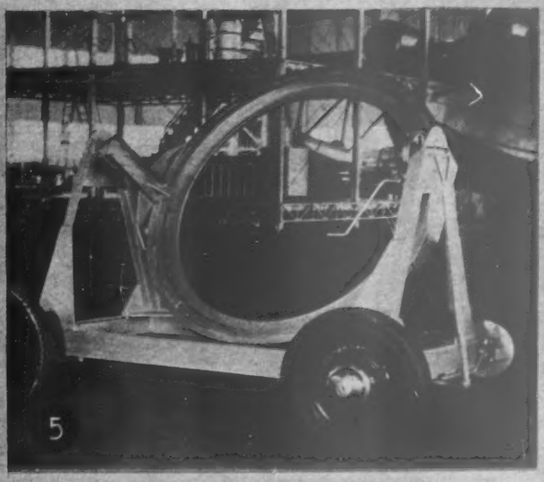
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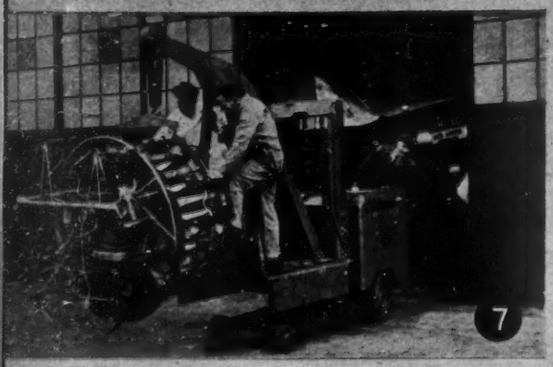
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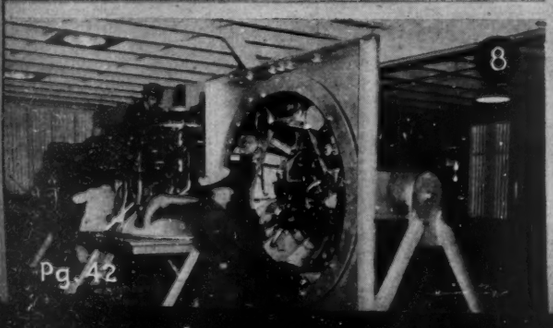
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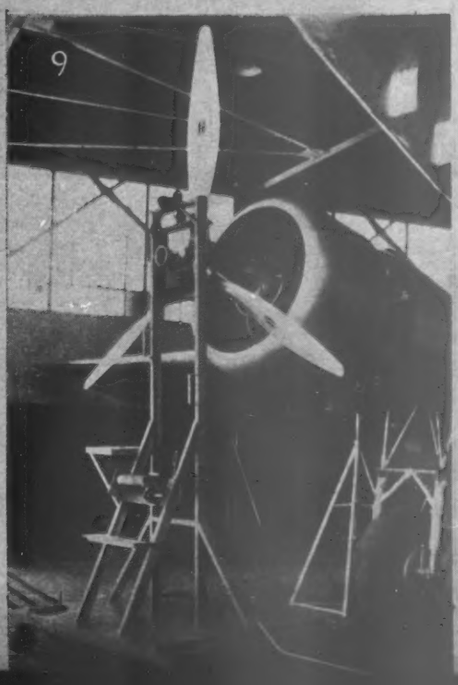
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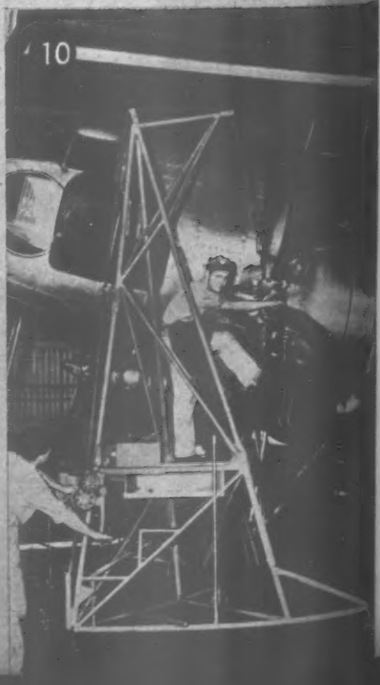
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ENGINES AND PROPELLERS

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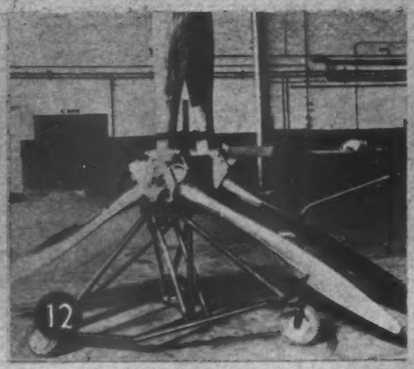
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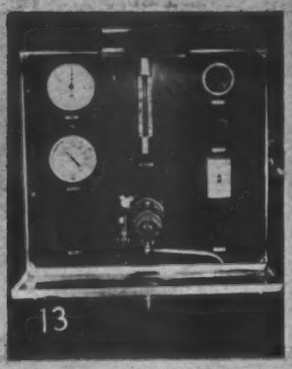
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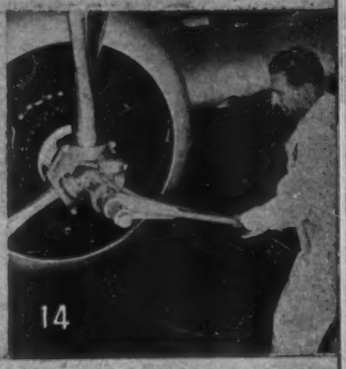
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(1) Complete power plant is handled on these unit nacelle stands. PAA. Miami.

(2) Self-mounted hoists for handling power plants on the PAA Yankee Clipper.

(3) Penn-Central's engine hoist is also used to transport engines over rough ground between shop and hangar.

(4) Engine mount stand for Boeing Clippers. PAA. Baltimore.

(5) Dolly for handling engine-nacelle units from Boeing Clippers. PAA. Baltimore.

(6) Northwest Air Lines "gooseneck" engine assembly stand.

(7) United handles engines in and out of overhaul shops with this special Baker electric hoist truck.

(8) Universal engine jig stand, double rotation type. PAA. Treasure Island.

(9) Hoist for propeller installation. PAA. Brownsville.

(10) Eastern Air Lines hoist and work stand for propeller installation.

(11) Propeller cart by Northwest Air Lines. St. Paul.

(12) TWA's propeller cart at Kansas City.

(13) Siebenthaler propeller governor control test unit which measure the amount of oil pumped by the governor at various speeds for a period of one minute. TWA. Kansas City.

(14) Special propeller wrench. PAA. Miami.

(15) Test bench and special equipment developed by United for servicing hydromatic propellers.

(16) Hood for buffing and polishing propeller blades. PAA. Brownsville.

(17) Eastern Air Lines' set-up for checking amount of oil pumped by propeller governors.

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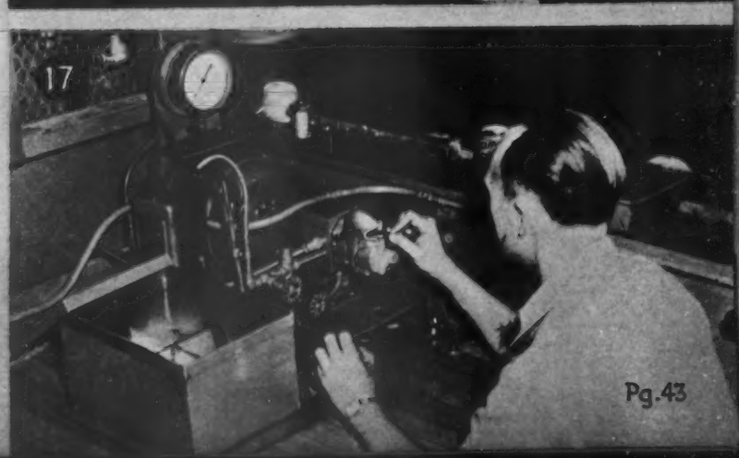
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ENGINE OVERHAUL

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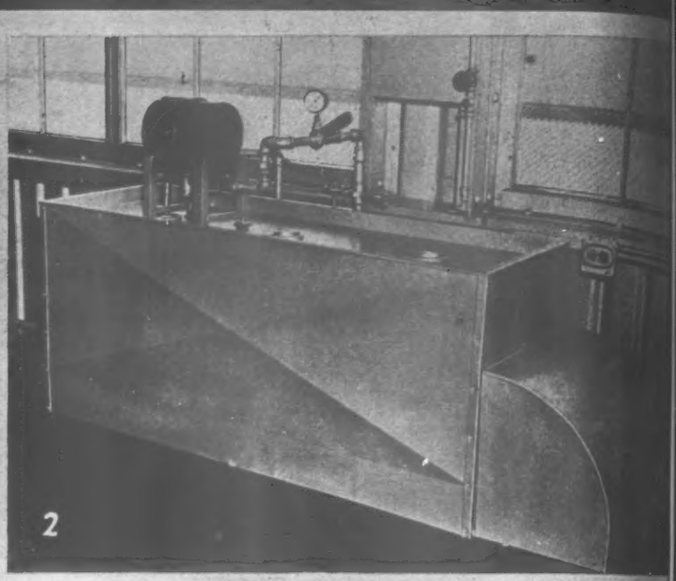
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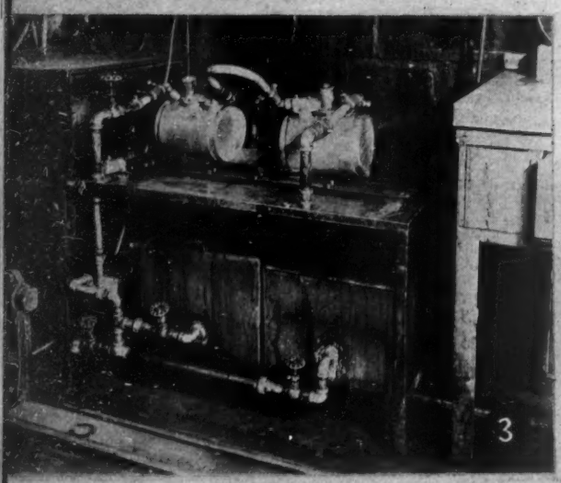
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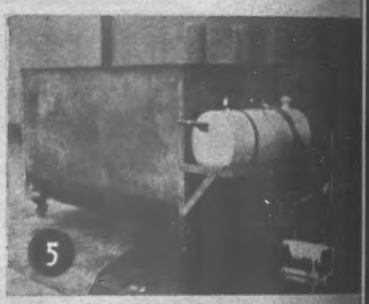
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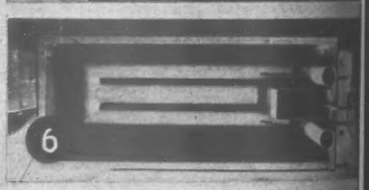
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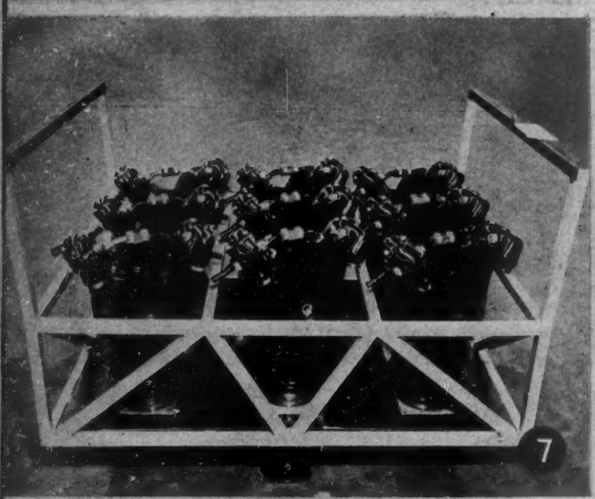
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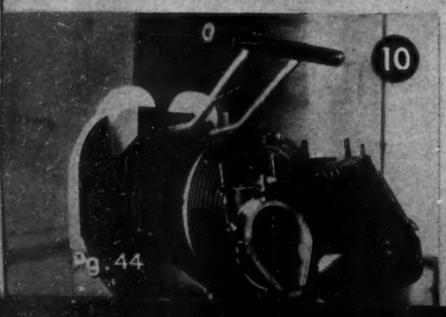
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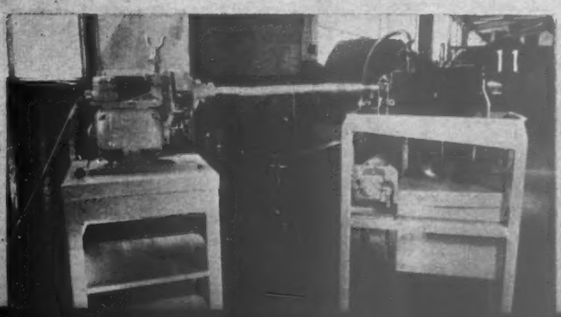
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(1) United's apparatus for cleaning sludge and oil out of oil tanks by forced circulation of cleaning fluid.

(2) Oil radiator cleaning and test bench as set up by Pan American at Miami.

(3) United cleans two oil radiators at a time, first flushing with carbon tetrachloride for one or two hours, followed by Turco Penetrol solution, with final cleaning by steam and oleum spirits.

(4) Mid-Continent uses a Romec fuel pump to circulate Penetrol through oil radiators for cleaning.

(5 and 6) A clever portable cleaning tank heated by a gasoline burner discharging into a submerged tube system. (above) Fuel tank and burner unit. (below) Plain view showing heating coils. Developed by Boston-Maine.

(7) Pan American at Miami handles cylinders in this convenient dolly.

(8) Automatic compressed air cylinder and piston ring lapping machine originally developed by United at Cheyenne.

(9) A similar cylinder honing device built by Northwest Air Lines.

(10) NWA's cylinder vise.

(11) Valve guide reamer set-up at Pan American's Brownsville shop.

(12) PAA type cylinder vice (Brownsville).

(13) EAL checks crankshaft alignment. Shaft assembly is placed on ball bearing forks and reading are taken on surface gage, right.

(14) American Air Lines uses this fixture and tool to lap oil seal rings on engine superchargers.

(15) American uses this simple magnetic compass device to check engine parts for residual magnetism.

(16) The Naval Air Reserve Base at Floyd Bennett Field has developed this useful rack to hold the complete parts for a 14-cylinder engine.

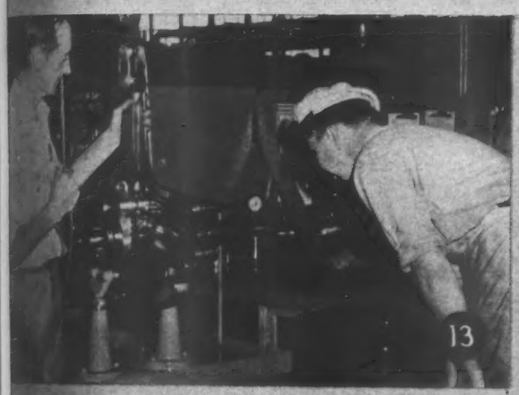
(17) Eastern Air Lines' equipment for checking carburetor float levels.

(18) By using a torque indicating wrench, American is insured uniform nut tightness.

(19) United's fireproof bench for checking carburetor characteristics after overhaul.

(20) Automatic mixture control test bench. Northwest Air Lines.

(21) Eastern's automatic carburetor and mixture control test stand.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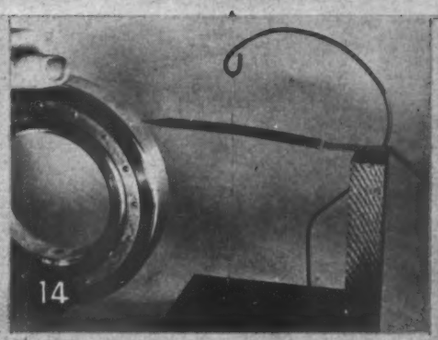
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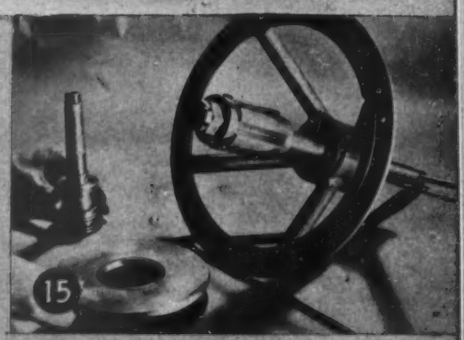
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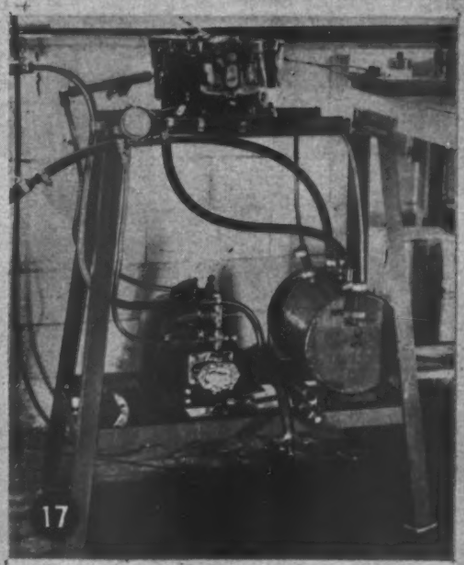
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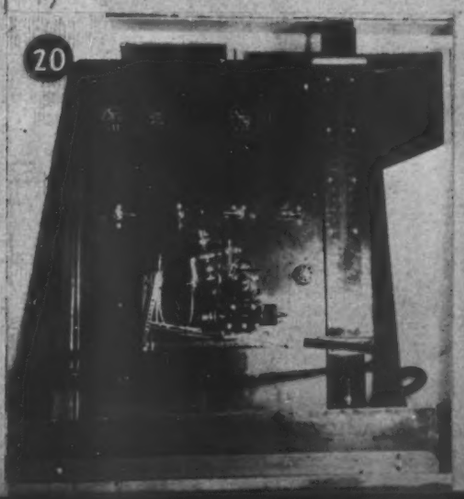
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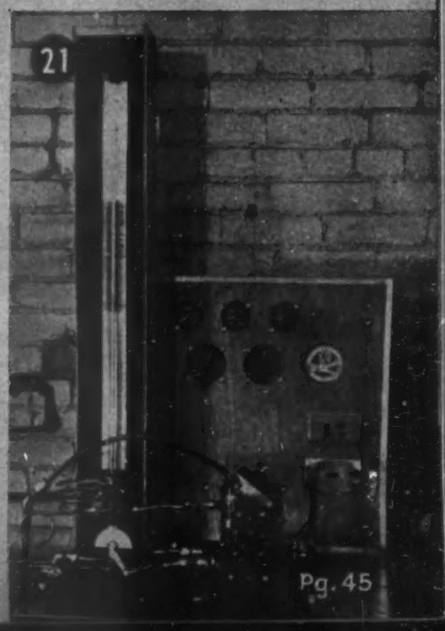
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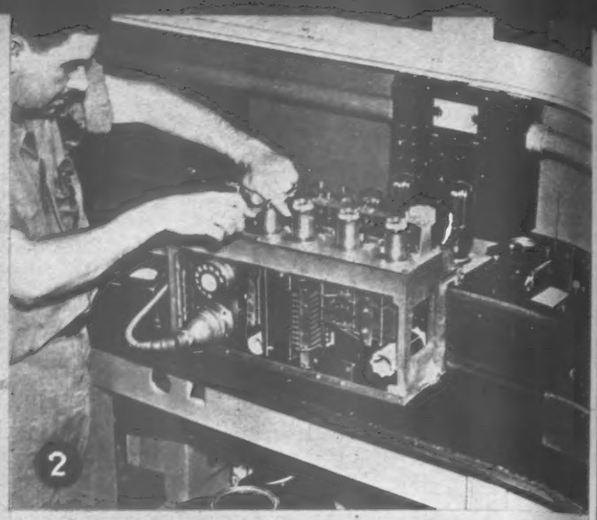
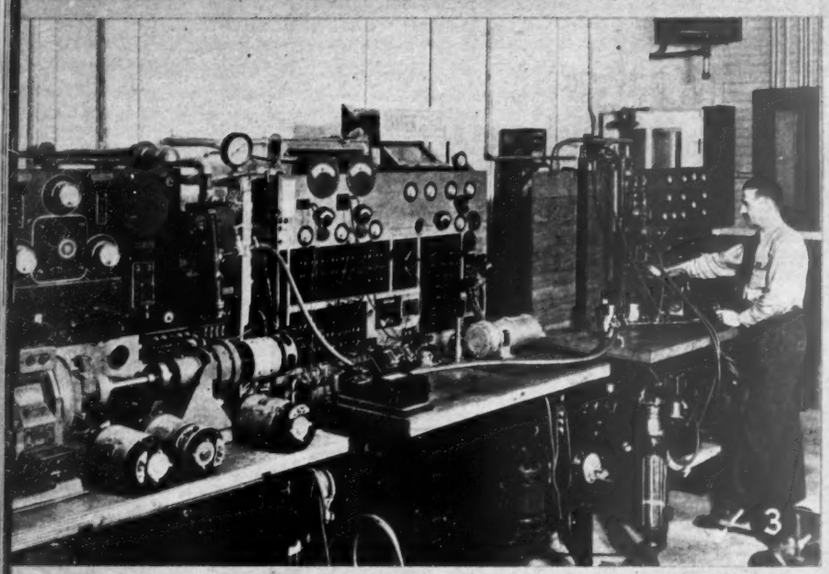
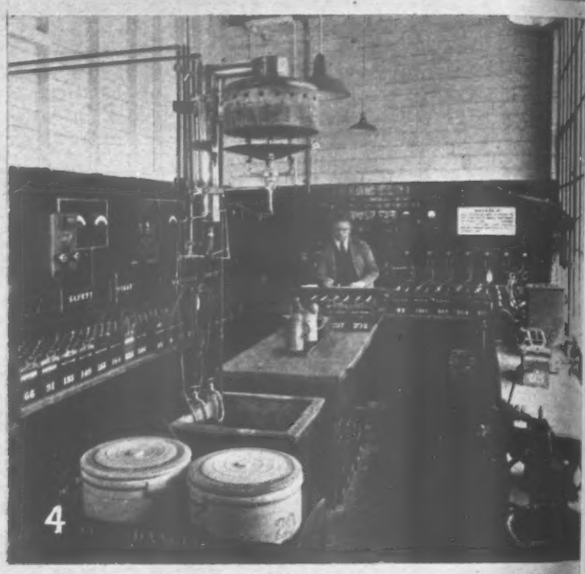
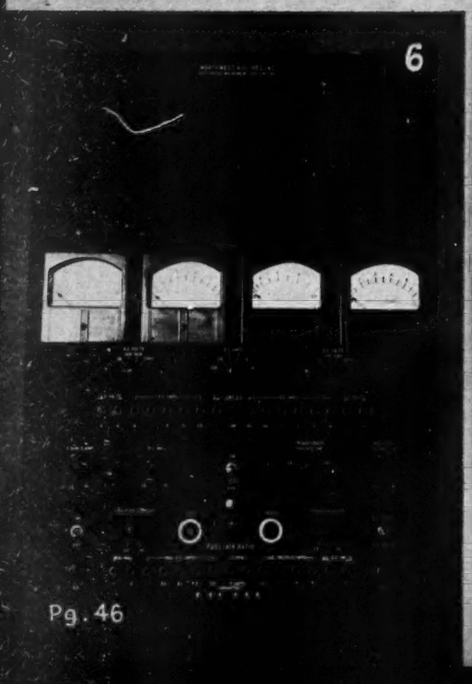
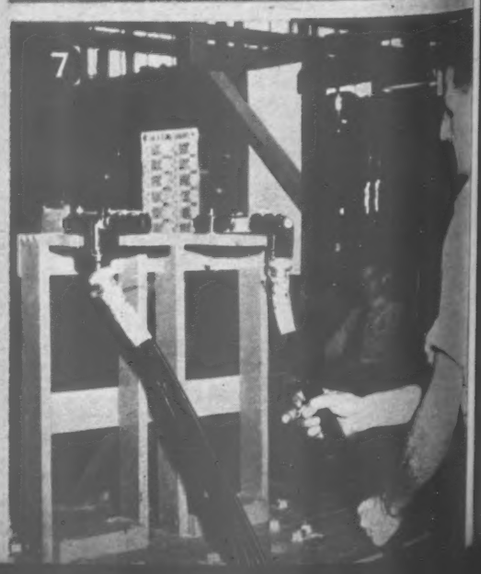






ELECTRICAL AND RADIO





(1) United's electrical and radio test equipment is mounted on standardized panels on relay racks.

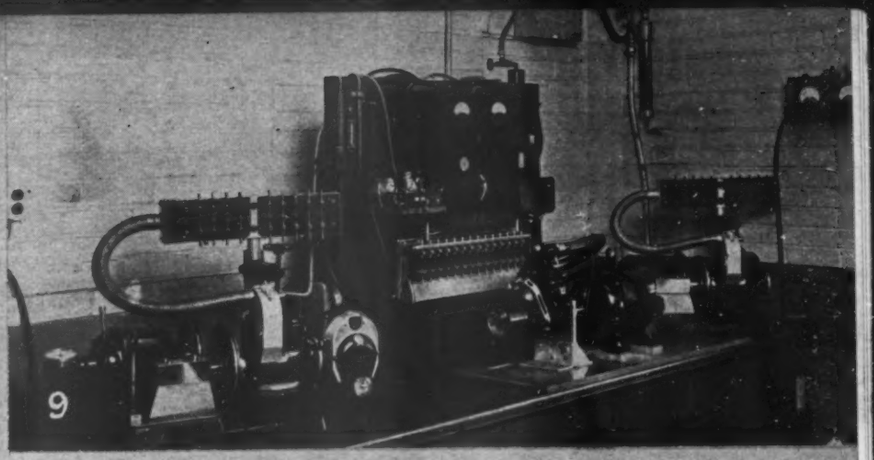
(2) A corner of Braniff's radio maintenance shop showing permanent installation of test equipment.

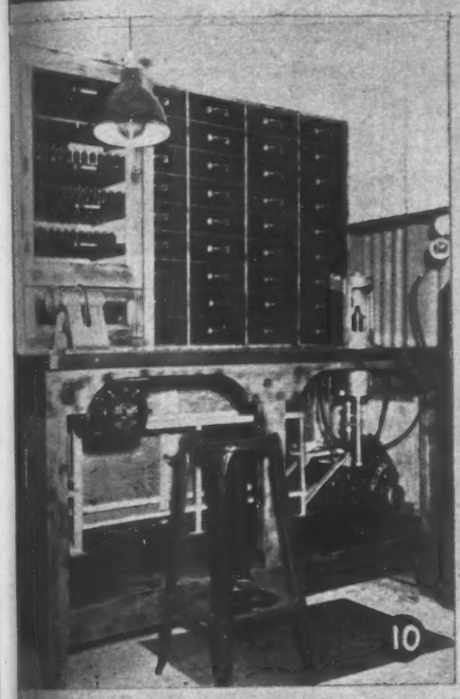
(3) United's generator and starter test benches. To right, bench for testing dynamotors, booster coils, master switches and solenoids.

(4) A corner of UAL's storage battery maintenance department at Cheyenne.

(5) United's machine for impregnating fabric braid on the spark plug end of ignition cables to prevent moisture absorption and subsequent engine failure. Composition is forced into the fabric for fifteen minutes under 15 lbs. per sq.in.

(6) North West Airlines electrical instrument test panel.





(7) Jig for assembling engine ignition harness as developed by Eastern.

(8) EAL's tool for grinding electrical contact points. Points are mounted on motor shaft and polished against emery paper placed on adjustable table.

(9) Test bench set up for 14-cylinder magnetos. United, Cheyenne.

(10) Spark Plug overhall bench at PAA's Treasure Island Base. Note heated cabinet at left to drive moisture out of plugs.

(11) Special torque limiting spark plug assembling wrench for assembling cores and shells. PAA, Treasure Island.

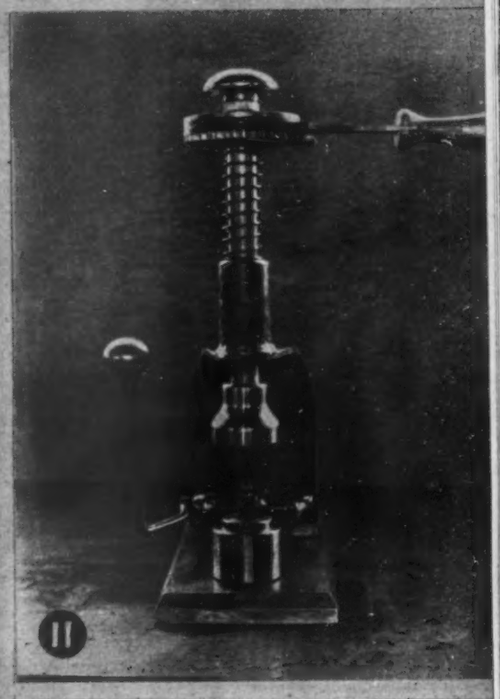
(12) Siebenthaler spark plug test and adjustment equipment. TWA, Kansas City.

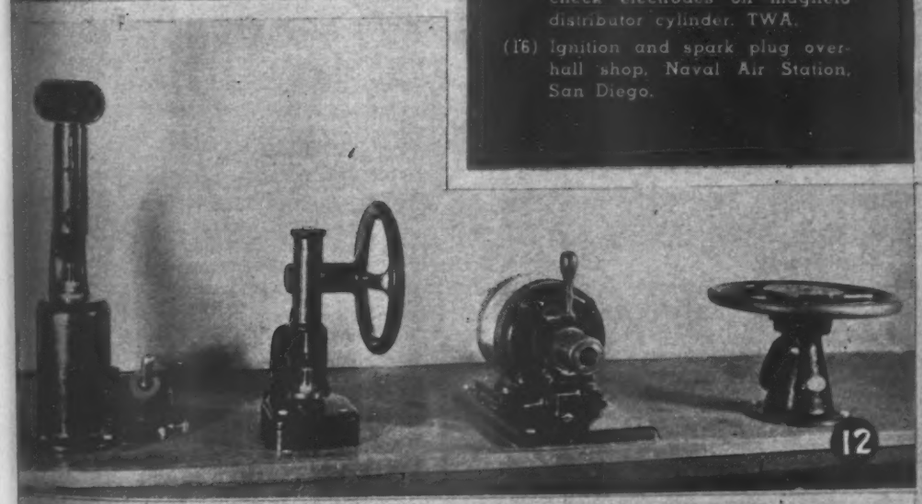
(13) Jig for setting end clearance on magneto shaft, TWA.

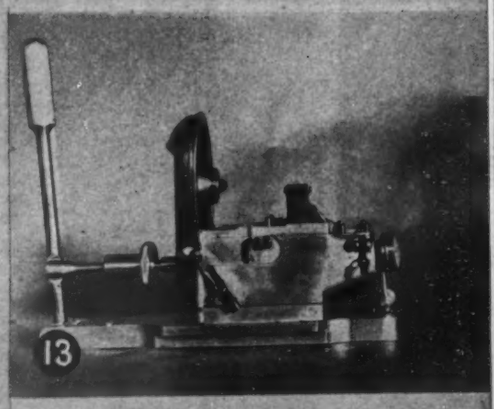
(14) Device for milling electrodes in magneto blocks. TWA.

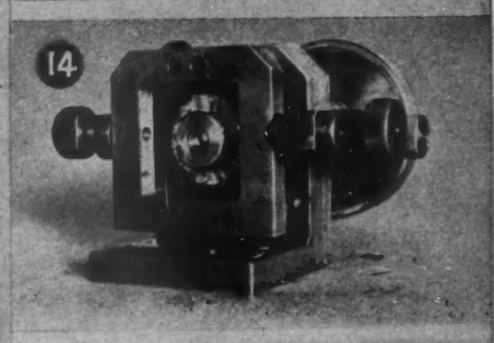
(15) "Go" and "No go" gage to check electrodes on magneto distributor cylinder. TWA.

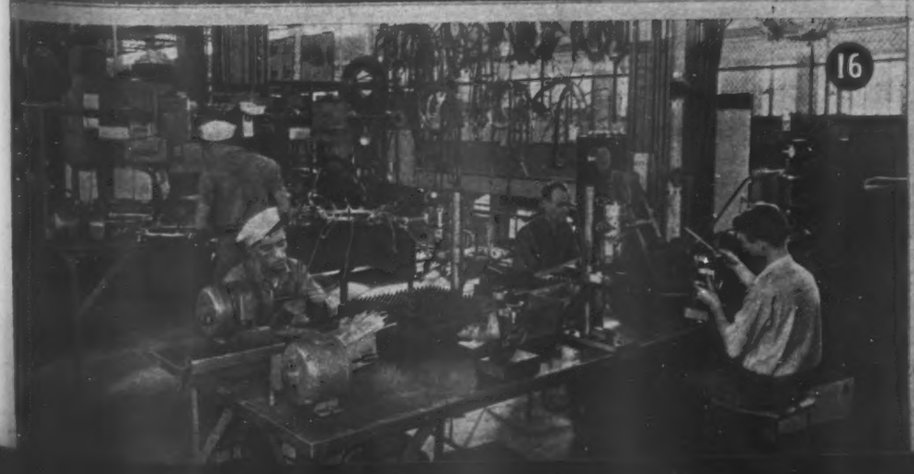
(16) Ignition and spark plug overhall shop, Naval Air Station, San Diego.

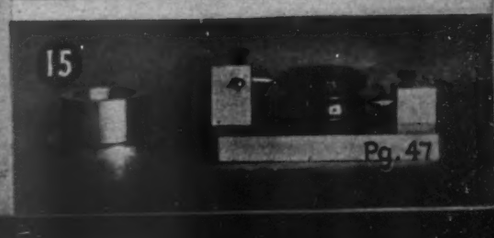


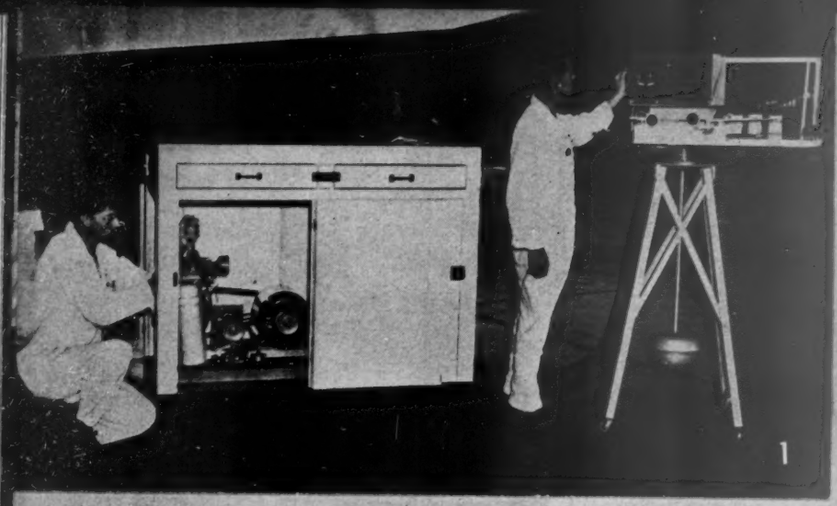


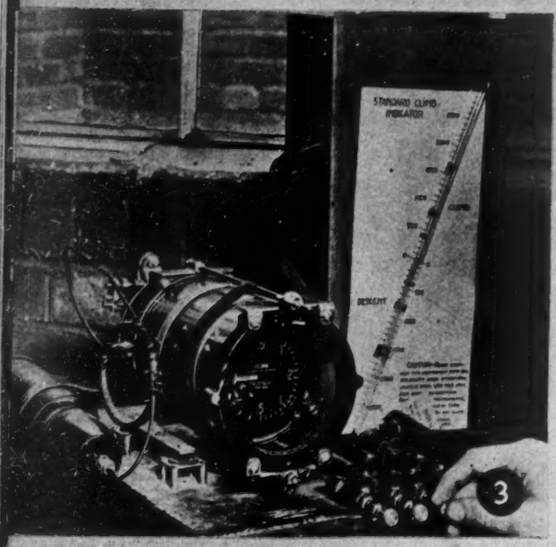


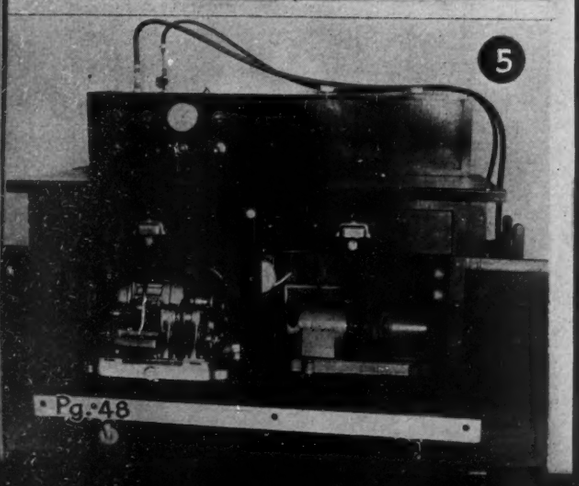












INSTRUMENTS

(1) Special rig for testing Sperry gyro pilots. Cabinet at left contains vacuum pump. Universal swing stand at right. PAA, Miami.

(2) All electrically operated flight instruments may be checked on this electrical test panel. PAA, Miami.

(3) United's agitated pressure chamber for testing barometric scales and balance on altimeters, as well as calibration of climb indicators. At Cheyenne (6200 ft. el.) it is necessary to use pressure to lower the chamber to sea level conditions.

(4) United has developed standard test panels for all aircraft instruments. In racks, left to right,— tachometer test stand, pressure gage test (10 to 3000 lb. per sq.in.), low pressure and vacuum gages. Necessary piping and wiring are permanently installed.

(5) PAA's portable test equipment at Rio. Left side, to check automatic pilots and other vacuum driven instruments without running engines. Right, to check electrical installations without batteries or without running motor, or to check control box operations without using engines.

(6) Hydraulically-driven Sperry Gyro pilot test equipment. The unit can be adjusted to any roll, turn, or pitch with one lever on the front. PAA, Treasure Island.

(7) Test bench for calibrating thermocouple gages. Lewis potentiometer used for calibration (right). Small electrically heated oven attached to rear of table for heating thermocouples.

(8) Instruments for grading ball bearings used in Sperry instruments. Does not measure diameters but selects balls of uniform size and trueness by comparing between quartz optical flats. UAL.

(9) Portable test units for calibrating high pressure gages on Douglas landing gear system. PAA, Rio.

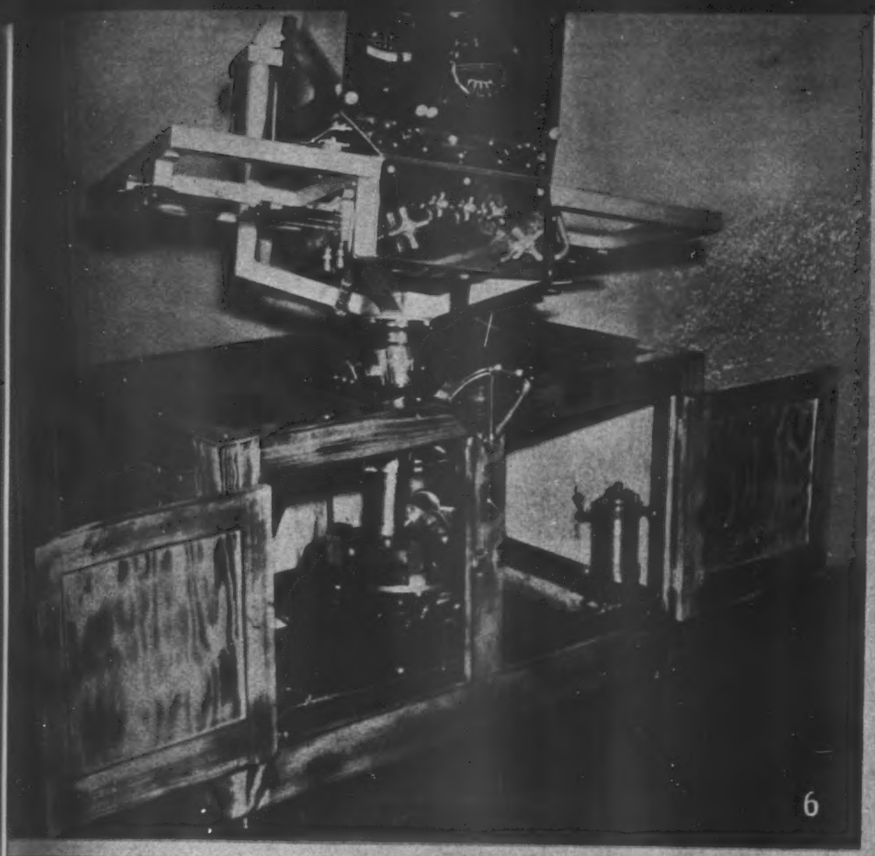
(10) Mid-continent's adjustable Scorsby for checking Sperry directional gyros. Support element is a Lord rubber mount.

(11) Inclinable test stand for checking operations of directional units. PAA, Rio.

(12) A handy cabinet for storing spare instruments and instrument parts as developed by Pan-American at Rio.

(13) Test stand for turn and bank indicators. Note manometer located on turning table which permits continuous turning in either direction without twisting the rubber tube. Note also friction drive.

(14) Corner of Braniff's electrical instrument overhaul department showing test stand for Cambridge analyzer in background.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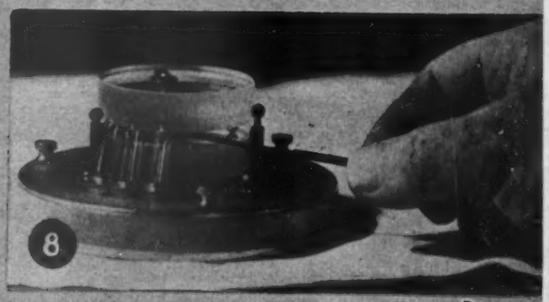
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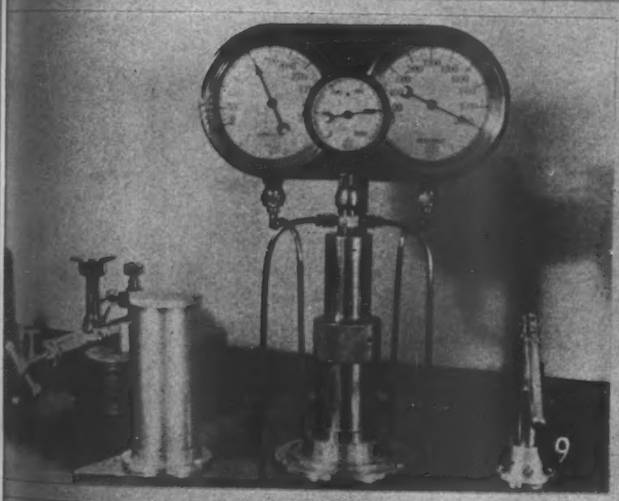
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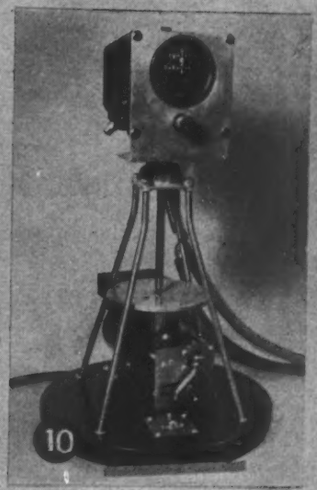
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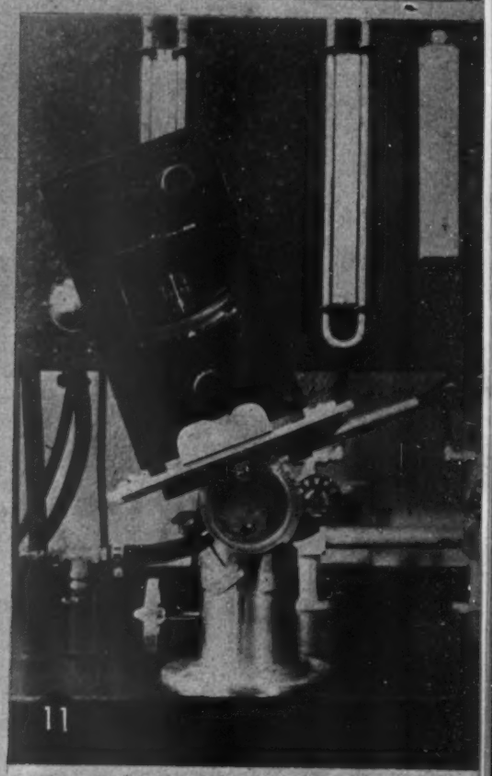
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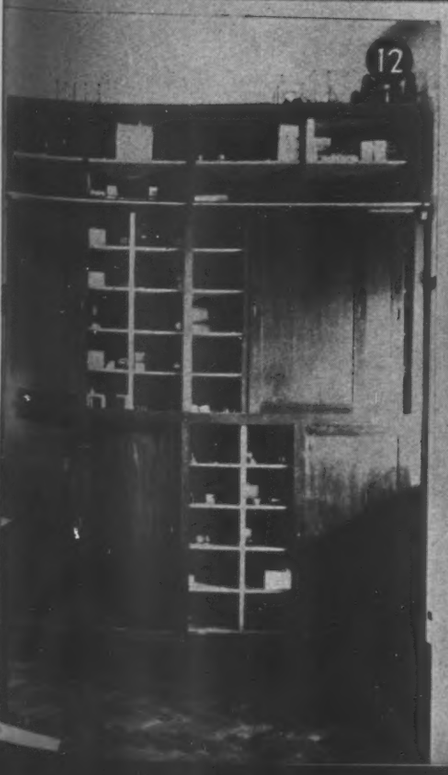
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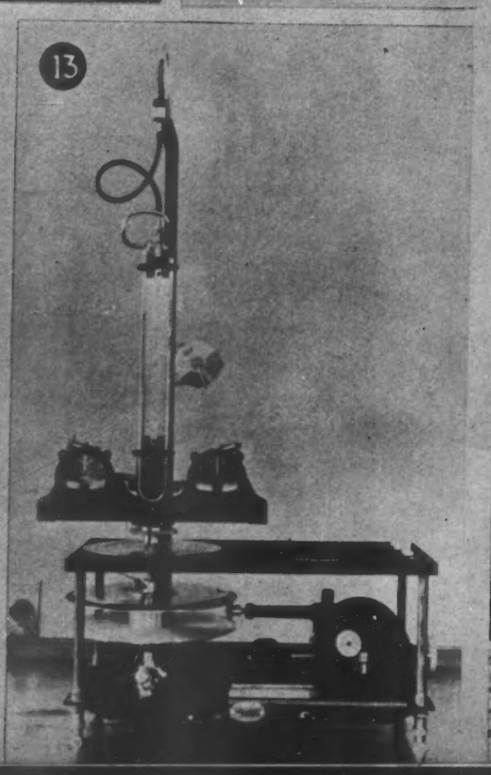
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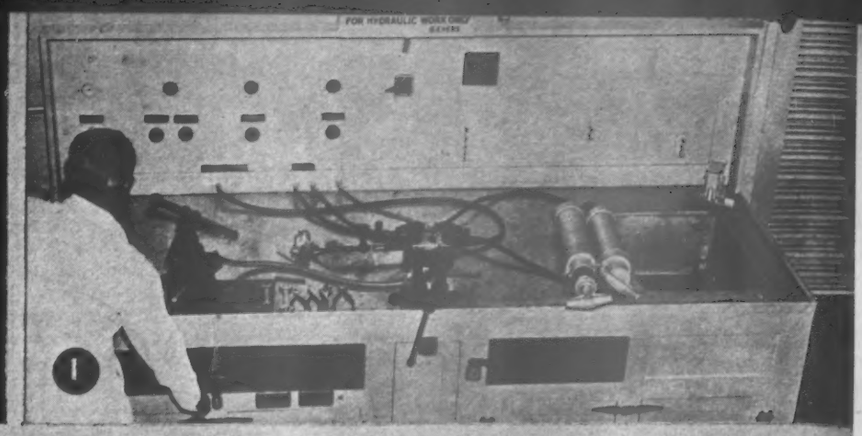
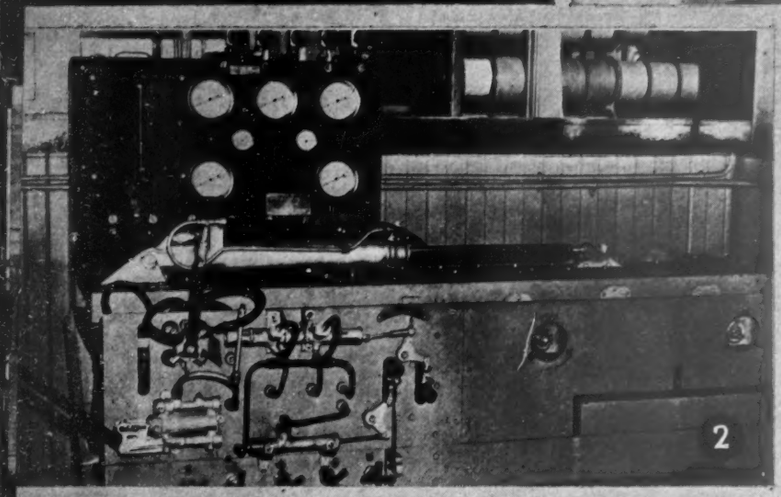
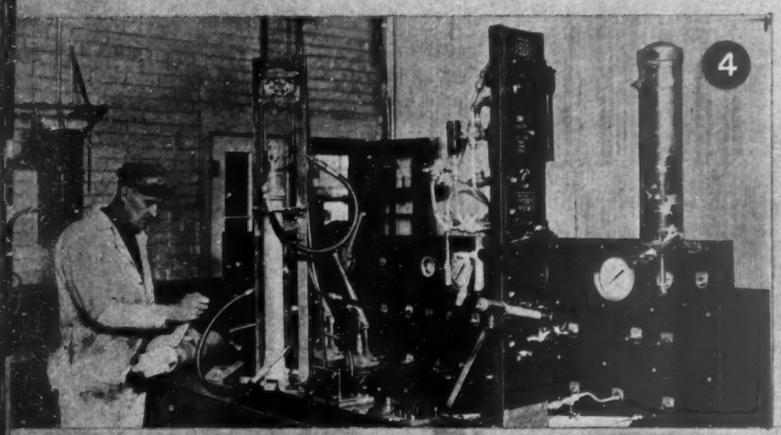
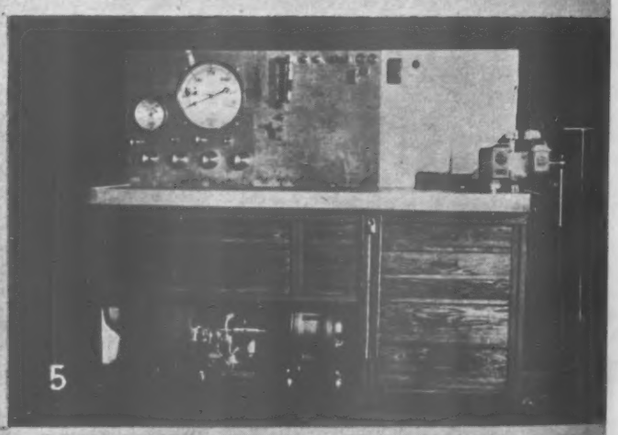
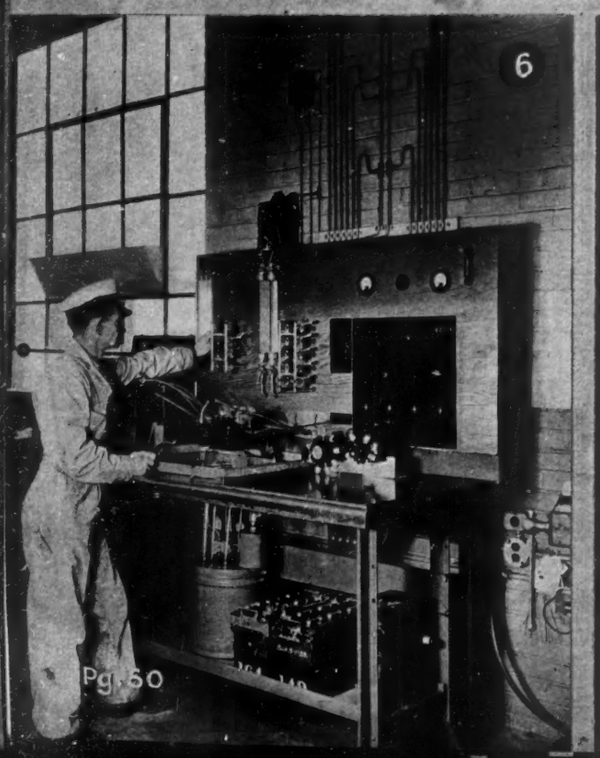
HYDRAULIC SYSTEMS











(1) Pan American Hydraulic Test Bench as installed at Miami.

(2) Braniff's complete hydraulic test unit. A Douglas landing gear strut under test.

(3) EAL's stationery hydraulic test stand. Air pressure system boosts hydraulic fluid from tank to pump. After tests fluid drains back to tank by gravity. Capacity up to 10,000 lb. per sq.in.

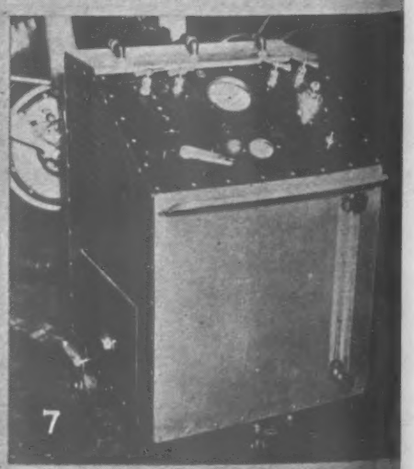
(4) All Douglas operating and control units are checked on this UAL bench.

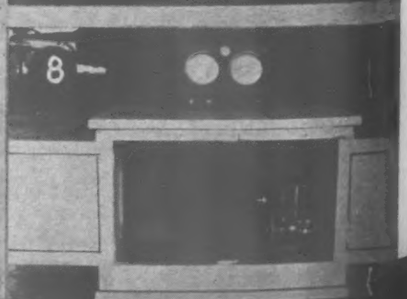
(5) NWA's portable bench is fitted with large, quick-reading pressure indicator.

(6) Checking De-icer pumps, valves, etc. in UAL's Cheyenne shops.

(7) Braniff's portable hydraulic tester for checking equipment in airplanes.

(8) PAA uses this portable bench at Rio for checking DC-3 hydraulic systems without running motors.





MAINTENANCE

In Non-Scheduled Operation

BESIDES the maintenance bases of the scheduled airlines there is a group of highly efficient repair stations whose function it is to care for the thousands of private owners and miscellaneous operators whose flying hours reach astronomical totals yearly. These bases range from shops comparable in organization and equipment to those of the larger airlines down to the one-man plant where a single aeronautical handy-man is often both jack and master of all trades. Somewhere along the line is the mechanics' school where overhaul work is done by students under the guidance of licensed mechanics.

But you can't judge the size of a shop by the area of floor space or the number of tools visible to the naked eye. Some of those that were doing the best jobs look only slightly larger than a couple of telephone booths and almost as devoid of equipment. Yet closer examination reveals the most ingenious hiding places for tools and gadgets and multiple uses for almost every piece of equipment.

Whether an operator is set up to do work in airline quantities or hires a single bright young man of all work, one of the important things to learn is that service breeds sales. And there is no better proof than the experience of progressive Hall Hemming who found that Stinson sales have been doubling and redoubling each year since the Booth-Hemming

1—Jim Borton (General Airmotive) is planning for the air races.

2—Al Novotny (Curtiss-Wright Tech) examines a Luscombe tail.

3—Arthur E. Tacey, Frank Say, J. O. Dowell (Booth-Henning).

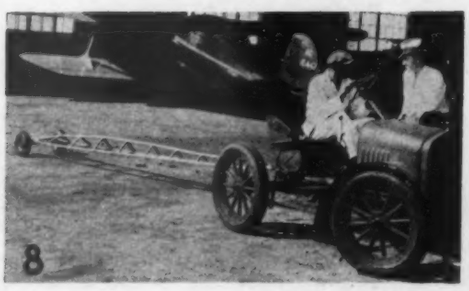
4—Hal Henning, who found service boosts sales.

5—Sheet metal department of Missouri Aviation Institute.

6—You could eat off the floor of "Chief" Kidder's shop at Glendale, Calif.

7—Portable high pressure air tank for inflating tires out on the line (Bredouw Airmotive).

8—Homer Bredouw's "jack-rabbit" tow car and tail wheel dolly.



maintenance base was opened early in 1936. Belonging to the group of bases that turn out airline-quality work, Booth-Hemming occupies a 25,000 sq. ft. hanger on Love Field, and goes so far as to provide a fleet of rental planes for the use of customers whose ships are in the shop.

Examples of the many little devices developed in the Booth-Hemming shops are the engine mounting plates and the engine parts racks covers. The mounting plates are heavy sheet steel beds, each such plate being designed to carry a particular model engine. All of these plates attach in identical manner to the rotatable engine dis-assembly stand, so the mounting and handling of engines during dis-assembly and assembly is greatly speeded. The engine parts racks covers are unique so far as we know, as all other shops rely upon washing the parts to remove any deposited dust. Of course they do that also at the Booth-Hemming base, but in order to assure maximum cleanliness of all parts during the period that the engine is dis-assembled, special tailor-made, quick-detachable canvas covers are provided to enclose the engine parts racks when they are not actively in use.

An example of a large maintenance base that grew out of a supply house is Pacific Airmotive Corporation which is now an all-around supply, service, maintenance, and aircraft storage base, approved by the CAA for every class of aircraft, engine, propeller, instrument, and radio work. In addition to its heavy business among private and non-scheduled aircraft operators Pacific Airmotive is under contract to maintain all of the engines operated by Western Air Express, and also does all engine overhaul for the Pacific Coast division of the U. S. Coast Guard, and Coast Guard aircraft overhaul under special contract. From a small store building the Pacific Airmotive plant has grown to its present dimensions of approximately 46,000 sq. ft. of floor space. Peak volume of business to date has been $750,000 in one year. Approximately 100 employees are now on the Pacific Airmotive payroll in connection with maintenance work.

Two clever service kinks have been developed at the Bredouw Airmotive Corporation repair station in Kansas City, Mo., both involving adaptation of "junk" equipment to a highly useful purpose at low cost, the sort of thing that can be done with a little ingenuity around any airport. Finding that there were a good many calls for supplying high pressure air to aircraft out on the line or actually on the field, Bredouw's service chief mounted an air storage tank on a pair of old auto wheels, equipped it

9—Major overhauling a Stinson in the Booth-Henning Shops.

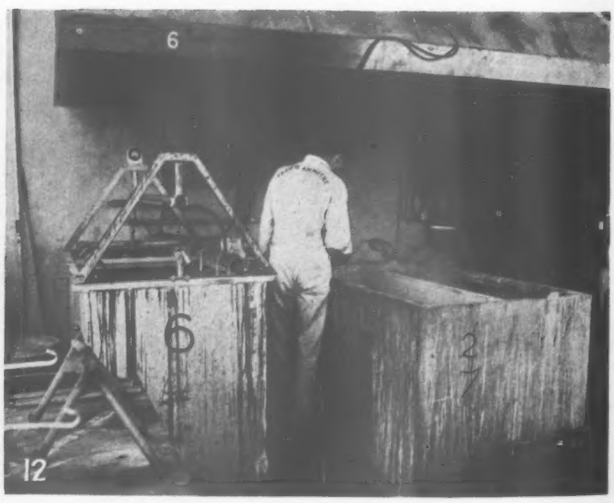
10—Engine mounting ring construction in the shops of Curtiss-Wright Tech.

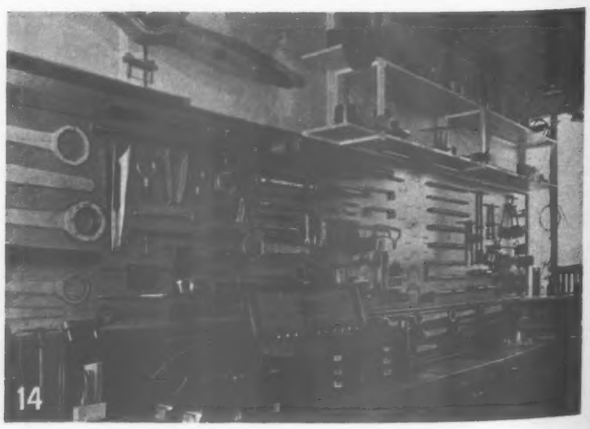
11—Banks W. Smith, California Flyers' president inspecting a wing repair job.

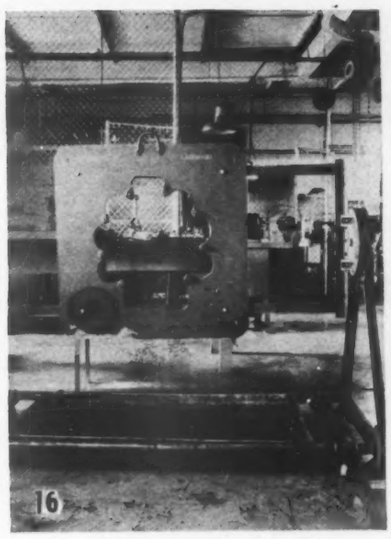
12—Anodizing tanks at the Burbank base of Pacific Airmotive Corp.

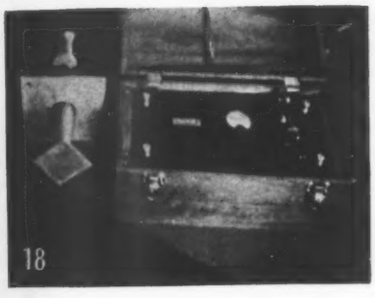
13—A corner of the tool room in the Curtiss-Wright Tech. shops.

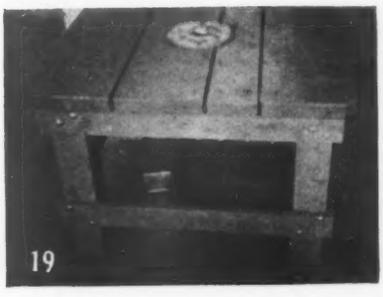
14—Pacific Airmotive has a compact tool board.

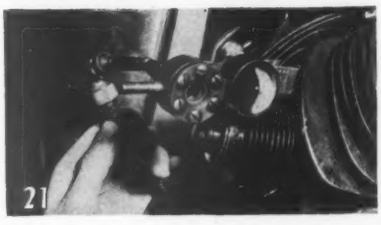


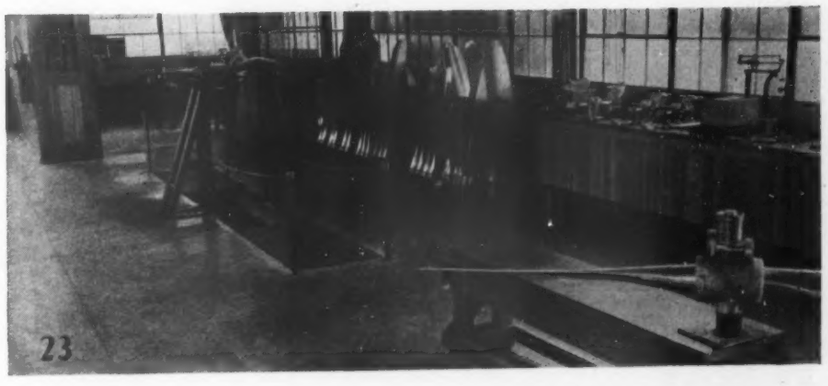












15—Portable engine test stand in approved repair station at Curtiss-Wright Tech.

16—Sheet steel plates developed by Booth-Henning for engine disassembly.

17—Canvas covers for engine tear down racks protect parts from dust in Booth-Henning shops.

18—Portable Magnaflux equipment for crankshaft examination developed by Chuck Foley.

19—A two-thirds saving in engine disassembly time is credited by Chuck Foley to this wooden bench.

20—Cable supported engine test stand used by Pacific Airmotive.

21—An ignition tester developed in the engine shops of the Boeing School.

23—A separate building houses the propeller shop of Pacific Airmotive.

22—Propeller pitch setter developed by Northwest Air Service.

with a suitable length of air hose and then pumped up the tank in the hanger. Another idea that has paid dividends was conversion of an old Ford chassis to a close-coupled "jack-rabbit" dolly tractor and airport service truck. This "jack-rabbit", equipped with a special low gear ratio, has proved ideal for bumbling transports around the field and in and out of hangars. A special dolly was developed to get under the tail of any of the modern transports, and carry the tail wheel.

California Flyers, Inc., operates a fleet of fifteen airplanes in connection with flight instruction work in the school. Therefore the school has found it profitable to obtain approved repair station rating in order to maintain all its own flying equipment. This plan also provides ideal work material for the mechanical students enrolled in the school. When work in hand permits outside repair jobs are contracted in order to keep the shops busy at all times with maintenance.

In connection with training hundreds of students in aircraft and

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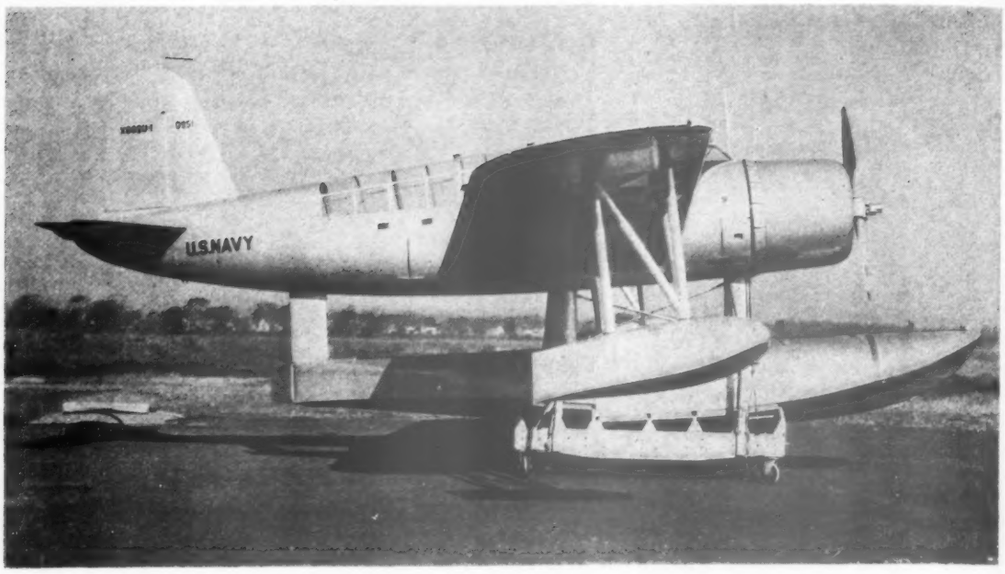
Flying Equipment

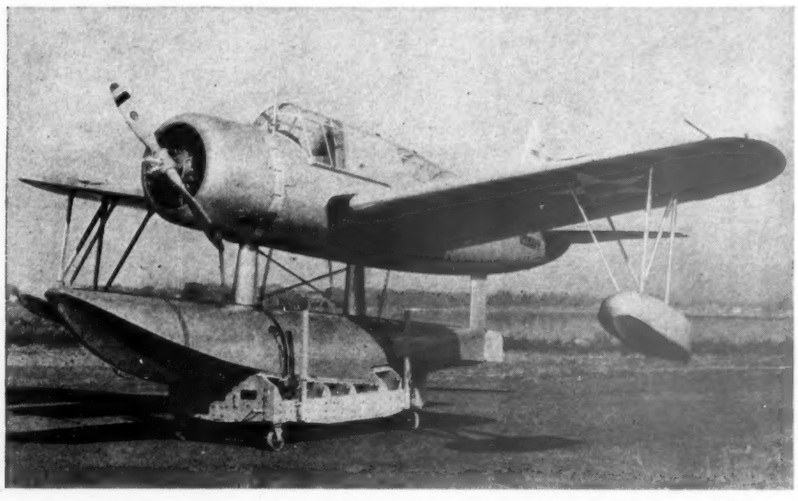


Spot welded aluminum alloy construction gives a sleek appearance to the Vought-Sikorsky

Spot Welded Airplane

New Type of Aluminum Alloy Fabrication Used in Vought-Sikorsky

THE pioneering work by Vought in spot welded aluminum alloy construction is now being applied to the manufacture of the Model XOS2U-I scout observation monoplane now under production for the Navy at the Vought-Sikorsky plant at Stratford, Conn. This type of structure not only simplifies fabrication but provides the smooth surface so much desired for improved performance as shown by recent researches of the N.A.C.A. Among the aerodynamic features of the new design are inclusion of deflector plate wing flaps, "drooping" ailerons, and spoilers. Drooping ailerons are designed to augment the action of the flaps while the spoilers improve the lateral control at low speeds.



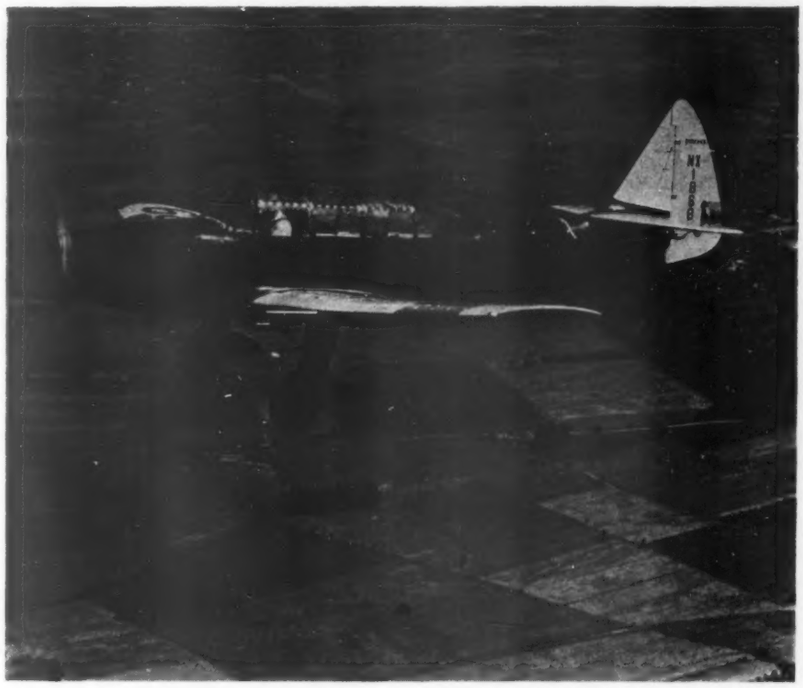
Nose and left wing showing float attachment

The XOS2U-I is a full cantilever, low wing type with all-metal monocoque fuselage. Power plant is the nine-cylinder Pratt & Whitney Wasp Junior engine having a take-off rating of 400 hp. Propeller is a Hamilton-Standard, two bladed constant speed type. Although it is available as a landplane, it is designed primarily as a single float seaplane for operation from battleship or cruiser catapults. Provision is made for a crew of two and the ship is chiefly intended to direct gun fire and for long range observation scouting missions. The monoplane type affords improved vision for the crew as well as performance exceeding that of the higher powered biplanes previously used and retains the desirable landing characteristics of the biplane type.

Overall span is 36 ft., length, 33 ft., 10 in. (seaplane) and 30 ft., 1 in. (landplane). Gross weight is 4764 lb. (seaplane) and 4542 lb. (landplane). Performance figures are not yet released. At the time of writing the ship has had more than 200 hr. of test flying. The Navy contract for this type represents $2,103,800.

Fairchild Trainer

Low Wing Tandem Monoplane has 6-cylinder, 165 hp. Ranger.



A LOW WING monoplane trainer with steel tube fuselage and all-wood wing has just been completed by the Fairchild Aviation Corp. Power plant is the Ranger 6-410B-2A. inverted engine rated 165 hp. at 2450 r.p.m. Designed to Air Corps requirements, the Model M-62 was conceived as a low-wing type to simplify the transition from training to service equipment.

Maintenance and structural advantages of plywood manufactured with phenolic resins dictated its use for wing covering. The basic structure of the wing is conventional, using spruce and plywood. Fixed semi-canteliver tail surfaces are similar to the wing in construction. Welded

The wide tread landing gear and flaps of the Fairchild Model M-62 Trainer.

chrome molybdenum steel tubing is used in fuselage with its integral engine mount and in the rudder construction. The elevator is built up of sheet steel ribs riveted to a torque tube.

Aerodynamically the wing has a tapered plan form using the NACA 2416 section at the root and the 4408 section at the tip. Leading edge slots and NACA type aluminum alloy flaps are used. Ailerons are statically and aerodynamically balanced. Their structure is of aluminum alloy, fabric covered.

Vertical landing gear struts are fitted with oil and spring shock absorbers having 8 in. of travel. Hydraulic brakes are controllable from both cockpits and 21 in. streamline wheels are used. The tail wheel is mounted on an oleo strut and is steerable through the full range of rudder travel. At extreme rudder positions, the wheel is released automatically to swivel.

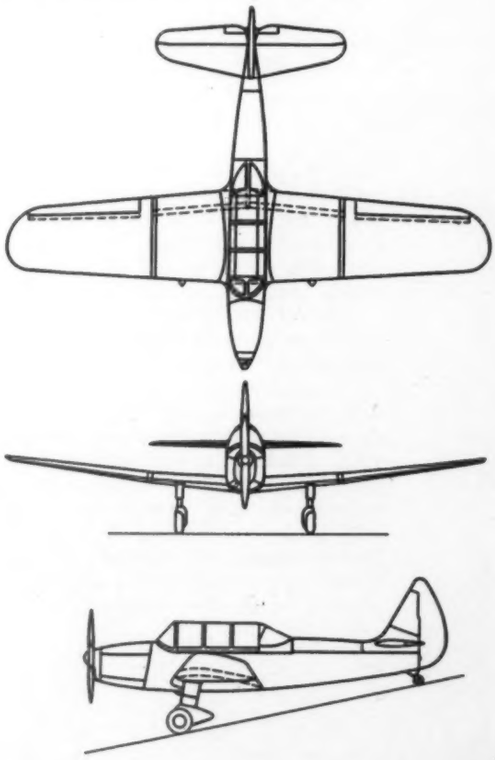
Tandem cockpits are covered by a sliding enclosure of Plexiglas or an alternate open cockpit arrangement is available. Seats are adjustable vertically and accommodate seat pack parachutes. Dual controls in the front cockpit are removable.

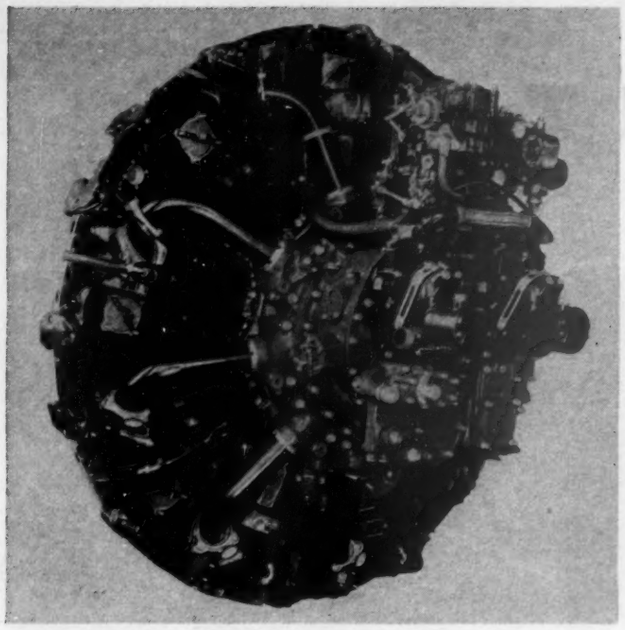
Instrument panels are rubber mounted and standard equipment includes compass, fuel gage, two airspeed indicators, pitot static tubes, altimeters, oil thermometers, tachometers, oil and fuel pressure gages. Space is provided for complete blind flying equipment, either indirect lighting or a Fairchild Moonglo may be provided.

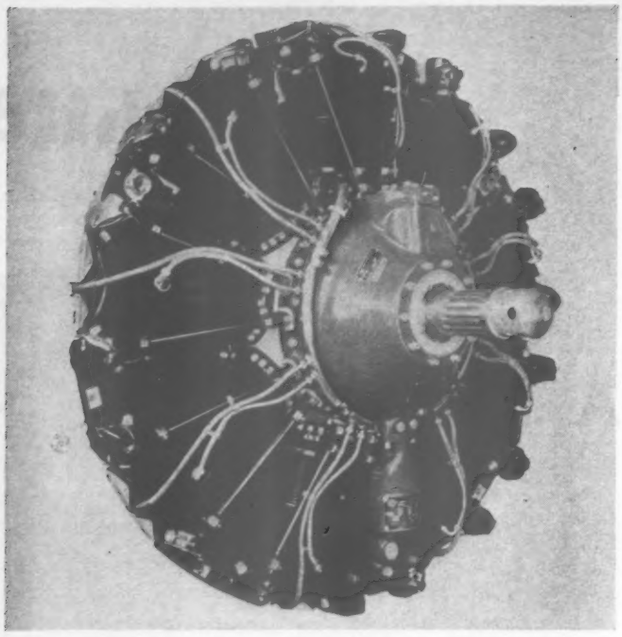
Fuel supply is carried in two 25 gal. wing tanks in the wing panels and 3¾ gal. of oil are carried in a welded aluminum tank mounted on the front side of the firewall. An engine driven fuel pump and an emergency wobble pump are used in the gasolene system. The exhaust manifold is a tapered collector attached to each part by curved stacks, and passing through a cooling tunnel in the lower cowl.

Specifications furnished by the manufacturer are as follows:

Wing Span	36 ft.
Overall Length	28 ft.
Overall Height	6 ft 8 in.
Wing Area	200 sq. ft.
Empty weight	1637 lb.
Useful Load	663 lb.
Gross Weight	2300 lb.







G-200 Cyclone

Wright Announces Release for Export of 1,200 hp. Engine

DOUBLE POWER OUTPUT for the same compression ratio is the eight-year record of Wright Cyclone development. The R-1820-E of 1931 was rated at 575 hp.;—the G-200, just released for export, has a take-off rating of 1200 hp. at 2500 r.p.m. For protracted sea-level operation the engine, equipped with two-speed supercharger, is rated 1000 hp. at sea level, 1000 hp. at 4500 ft., and 900 hp. at 14,500 ft., in the G-205 model. The G-202 has an identical take-off rating at sea-level and carries the 1000 hp. rating for protracted periods at sea-level up to 4500 ft. Crankshaft speed for protracted ratings is 2300 r.p.m. The single row G-200 has a bore of 6.125 in., stroke of 6.875 in. and compression ratio of 6.7 to 1. It is available as a geared engine with propeller speed reduction units of either 3:2 or 16:9. Dry weight is 1302 lb., or about 1.08 lb. per hp.

Cylinders are similar to those of the G-100 series but fins are closer and deeper on barrels and heads. New valve parts, valves and valve seats and increased shrink and form fit threads for head attachment are features. Intake pipes and exhaust parts have larger exits. The steel exhaust valve insert is of new design and a steel intake valve insert replaces the bronze type on previous models. Rocker box height has been increased slightly to provide bushings in the rocker arm bolt holes but covers have been modified so as not to increase the engine diameter. Covers have integral cast ears for baffle attachment. Two studs are provided on the front of each exhaust support box for the cowling. Twenty hold-down capscrews bolt the cylinder to the crankcase.

Magnesium alloy is now used for the crankcase nose section which houses the reduction gear unit and has been modified to provide for the vertical mounting of the constant speed propeller governor which is now driven through bevel gears from the cam intermediate gear.

The mounting section which is machined from an aluminum alloy casting, has been redesigned for stronger attachment to the rear main crankcase, using long capscrews instead of studs. Provisions have also been made in this section for the use of radial, instead of tangential, intake pipes. Mounting circle and spacing are the same as on the G-100 Cyclone.

The main crankcase, consisting of two halves bolted together at the centerline of the cylinders, is of steel as in the G-100 but is somewhat modified. The two halves are now bolted together internally and an integral flange is provided for the attachment of the nose section. This flange eliminates the necessity of providing stud holes in the web of the main crankcase, providing greater strength. It also forms an oil scavenging chamber which improves the scavenging characteristics of the engine. The front and rear main roller bearings are larger and no spacers or slingers are used. The bearing outside diameters assemble in steel sleeve, shrunk into the crankcase.

The supercharger rear housing is machined from a magnesium alloy casting and assembled with a new impeller and diffuser. Inlet passages have been enlarged and streamlined and the carburetor adapter has been inclined toward the rear and has been redesigned for greater flow capacity. Rear section gears are essentially the same as on the G-100 Cyclone. An automatic Cuno oil filter is included in the supercharger rear housing and the new standard Air Corps square pad spline drive fuel pump mount is provided.

The supercharger rear housing cover is also machined from a magnesium alloy casting. A six-stud in-

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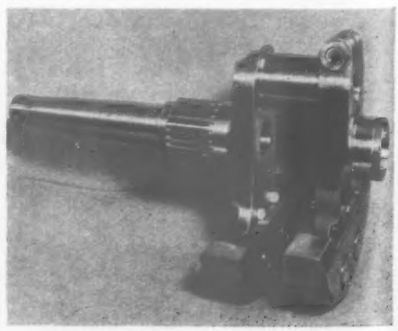
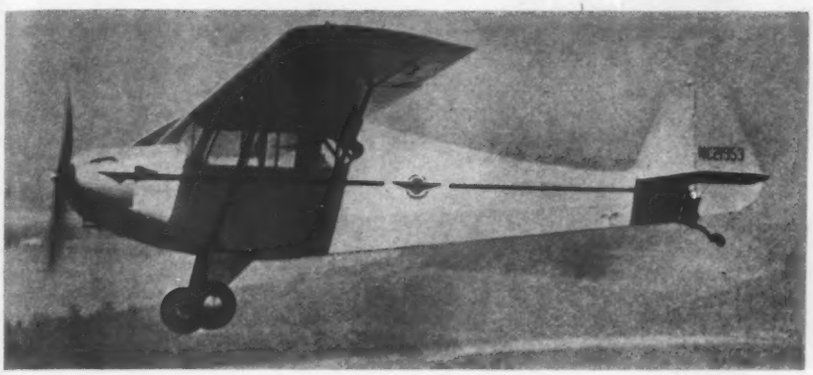
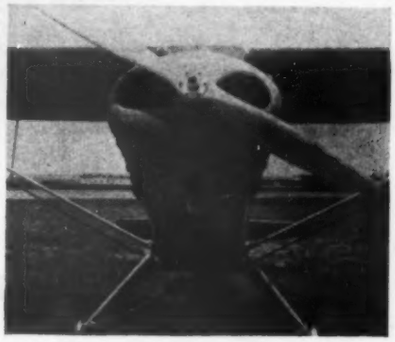


The Dynamic Damper is used in both counterweights.

Porterfield-Turner 50

65 and 75 hp. Models and a Trainer soon to be available.





Porterfield Turner 50 in flight (left). Front view showing nose cowling and landing gear (below)

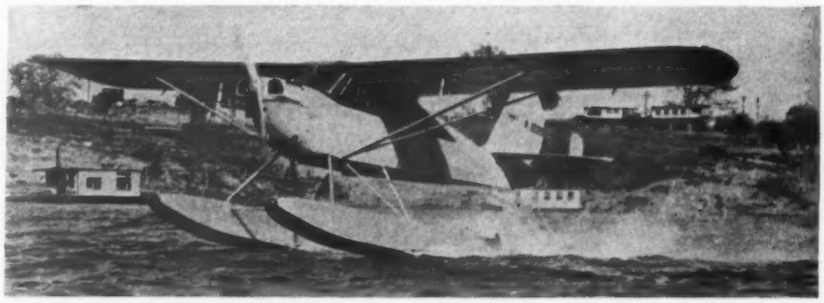
New machinery and personnel is being added to the facilities of the Porterfield plant to speed up production on the Porterfield-Turner 50, latest model in the line. Other models with 65 and 75 hp. engines are being test flown and a 2-place trainer is now under construction.

The Model 50 is a high wing cabin monoplane braced with two lift struts instead of the vee type of strut bracing. Wing spars and ribs are of spruce with steel tube tips, dural leading edge, and fabric covering. Aileron area is 15% of the total wing area. Dihedral has been introduced to improve lateral stability. Trimming tabs are controlled from either seat by a knob. Fuselage construction is conventional and the welded steel tube tail group is wire braced. Landing gear has a 65″ tread.

The roomy tandem seating cabin is entered through a large door, 40 in. wide 33 in. high. It is completely upholstered in synthetic grain leather with upholstered parachute seats. Ahead of the instrument panel is an 11-gallon gasoline tank. Behind the rear seat, in the turtle-back fairing is the baggage compartment 24 in. by 30 in. by 10 in. which accommodates 30 lb. of baggage.

Equipment includes dual stick controls and brakes, and non-glare instrument board, readable from either front or rear seat. Large Pyralin windows furnish excellent vision.

Power plant is the Continental 50 hp. engine having a fuel consumption of 3.25 gal. per hr.



Chief Goes Seaplane

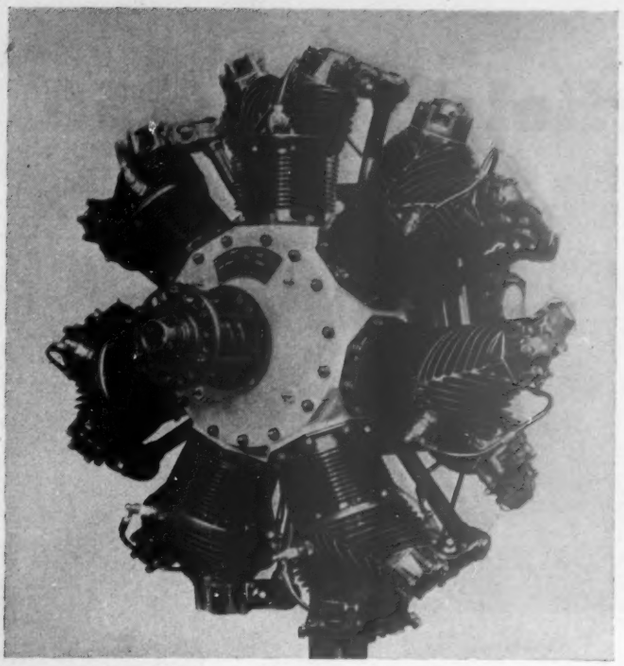
65 hp. Aeronca Now Available on Floats

Following fast after the trend to bigger and better lightplanes, Aeronca announces full approval of new Aeronca "Chief" 65 h.p. land and seaplanes. The two models are identical in construction, except for installation of Edo floats on the seaplane, and they are nearly identical in performance, cruising speed of the landplane being listed as 95 mph and of the seaplane 90 mph.

Following the same basic principles of design and construction as the present 50 h.p. series, the 65 h.p. "Chief" differs chiefly in provision for mounting of the new 65 h.p. Continental engine. Like previous models, the 65 h.p. "Chief" is a side-by-side two place monoplane with strut braced high wing. The land plane has a gross weight of 1150 lbs. and a useful load of 480 lbs., while the seaplane has a gross weight of 1253 lbs. and a useful load of 473 lbs. Outstanding feature of the two new models is the increased performance gained through use of greater horsepower, and the application of improved streamlining. Performance figures issued by the manufacturer are as follows:

	"Chief" Landplane	"Chief" Seaplane
Top speed	105 mph	100 mph
Cruising speed	95 mph	90 mph
Landing speed	35 mph	40 mph
Rate of climb		
First minute	600 ft.	500 ft.
Service ceiling	15,000 ft.	13,500 ft.

Flying Equipment



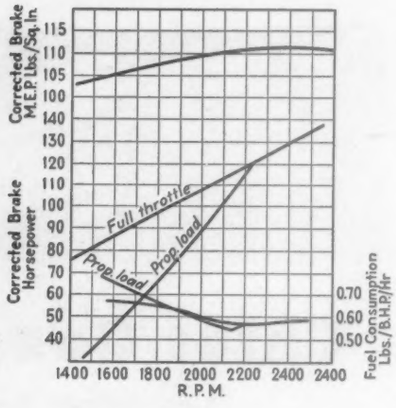
Flying Equipment

Ken-Royce Model 7F

Higher rating approved for Development of Le Blond 7DF

THE Rearwin Aircraft & Engines, Inc., announces that A.T.C. No. 52 has been granted on a new engine, Model 7F, rated 120 hp. at 2225 r.p.m. This is a development of the Le Blond Model 7DF at 110 hp. Increased power has been attained principally by increasing the compression ratio and the r.p.m. Many other changes have been built into the engine, including three bearing crankshaft, cadmium silver master rod bearings to replace the babbitt bearing formerly employed at this point, rocker arm rollers instead of tappets, harder cylinder barrels, etc. The new model will supplement the Model 5E (70 hp. at 1950 r.p.m.) and the Model 5F (90 hp. at 2250 r.p.m.) Simple design features and interchangeability of parts were emphasized during the development of all three models and as a result nearly 90% of the parts are interchangeable. Design and manufacturing details have been furnished by R. W. Rummel, chief engineer.

The crankshaft on the Model 7F (interchangeable on all models) is manufactured from drop forged 3240 steel, machine finished all over and dynamically and statically balanced by two bronze counterweights. The hollow crankshaft is supported by three ball bearings and is provided with a SAE No. 0 taper end. The



cam drive shaft which forms a part of the gearcase assembly pilots into the end of the rear journal and is driven by lugs which fit into the slot at the end of the crankshaft. These lugs are off center so it is impossible to assemble the crankshaft or the gearcase except in the correct position, once the valve timing is adjusted. A patented plug in the crank pin originally developed by Le Blond is so arranged that any extraneous particles of dirt in the oil, which are naturally thrown to the outside by centrifugal force, become permanently trapped and are thereby prevented from passing through the master rod bearing.

The pistons on the Model 7F, as on the Models 5E and 5F, are permanent mould aluminum alloy catings. Pistons have full skirts and three rings above the piston pin, the lower ring functioning as an oil scraper. The head of the piston is ribbed underneath, which permits proper cooling. Full floating hollow piston pins are employed.

Articulated type connecting rods of an extremely simple design are employed. The rods are made from nickel chromium steel drop forgings of H cross section and are polished to a high finish. The master connecting rod and cap have a full bearing upon the crankpin. The Federal-Mogul connecting rod bearing is a split shell type lined with a cadmium silver copper alloy. The bearing is held in place by a pressed out lip that fits into a slot in the rod and cap. The cap and master rod are held together and dowelled by four nickel steel bolts. These bolts also securely lock the wrist pins in place which eliminates numerous small parts that might otherwise be necessary. These bolts have square heads resting against shoulders that prevent turning and are made tight by long hexagon nuts locked by cotters.

The link rods, interchangeable on all models would be reversible were it not for the oil hole in the outside which permits splash lubrication of the piston pins. Bronze bushings are pressed into each end of the link rod and the upper end of the master rod.

Crankcases on the Model 7F are machined from heat treated aluminum alloy castings of high tensile strength. The crankcase has a large opening on the front through which the crankshaft and connecting rods may be inserted as an assembly. A similar opening is provided at the rear which permits attaching the gearcase assembly. The inlet manifold is a separate cored passage in the form of a ring with openings to receive the inlet pipes and an opening which connects with the carburetor through the oil sump. This serves partially to warm the vapor mixture and cool the crankcase. A wall central with the inlet manifold provides the support for the rear crankshaft bearing which is supported directly on a steel sleeve pressed into the crankcase and held in place with three countersunk head screws permanently locked from turning.

Cam follower bushings are manufactured from hollow cast iron bushings ground to close limits. These are pressed into the crankcase and

(*Turn to page 95*)

Going Places In 1939? . . . Then Let This FREE MANUAL Help You

You will find that this Manual explains pilotage and flight technique from the ground up. It has been specially compiled by the editors of AVIATION to meet the needs of Students, Pilots, Mechanics, Plane Owners, Fixed Base Operators, Transport and Airport Men. It is yours, without cost, with your subscription to AVIATION—the monthly issues of which bring you equally practical ideas for making your way in your chosen work.

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A 500-Cycle
Blind Landing System

By Edward Nelson Dingley, Jr.

Bureau of Engineering, Navy Department

IN 1920 there was developed a most interesting device or system which came to be known as the Ambrose Channel Piloting Cable. This consisted of an armored submarine cable which was laid on the floor of Ambrose Channel in New York harbor from the lightship to a point on the Brooklyn shore; a distance of approximately five miles. At the lightship end, the inner conductor of the cable was grounded to the armored sheath and at the Brooklyn end the circuit between the inner and outer conductors was connected to a generator which supplied a current of approximately five amperes at five hundred cycles.

The vessel to be piloted by this cable was equipped with two loop collectors secured respectively at the opposite bridge wings in vertical fore and aft planes. The loops were within forty or fifty feet of the cable and each loop was spaced from the other by a distance of the same order and so it is obvious that as the vessel deviated from the center of the channel one of the loops would be not only nearer to the cable than the other but also its plane would more nearly intersect the cable and consequently one of the loops would have induced in it a greater voltage than the other. To make use of this system, the pilot of the vessel was required to wear the headphones and to throw a switch back and forth in order to determine which loop picked up the greatest signal. This information, of course, indicated on which side of the cable his vessel was situated at the moment.

At first glance, it is obvious that an identical system would not serve to guide an aircraft even in horizontal flight at an altitude of, say, a thousand feet. In the first place, the spacing of the loops mounted on the wing tips would be so small compared to the distance to the cable, that the voltages induced in the loops would be nearly identical regardless of the position of the aircraft with respect to the cable and in the second place, if the sheath of the cable constituted the sole return path, the field external to the cable would be negligibly small whereas if the earth were used for the return circuit the external field at an altitude of a thousand feet would be only slightly improved and the resistance of the earth circuit would require high voltages and a large amount of power in order to achieve the required current flow through the cable.

These difficulties may be overcome if two cables are laid on or buried under the ground so as to be parallel to each other and spaced apart in a horizontal plane by a distance equal to twice the desired altitude of the aircraft. In the case of the system recently installed and successfully tested at Lakehurst, N. J., by the Navy Department, the cables are joined at their far ends by a shunting conductor and one cable is used for the outbound circuit while the other is used for the return circuit. This constitutes a large horizontal loop. In the aircraft, the two collector loops are mounted with their planes at right angles to each other and with the plane of each loop lying at forty-five degrees to the horizontal so that when the aircraft is in horizontal flight directly above the mid-line between the two cables and at an altitude equal to half the distance between the two cables, the plane of each collector loop of the aircraft intersects one ground cable and at the same time is perpendicular to a plane intersecting the other cable. In consequence, each collector loop receives an optimum signal from one ground cable and no signal from the other. The relative positions of the ground cables and of the collector loops in the airplane are shown in Figure 2.

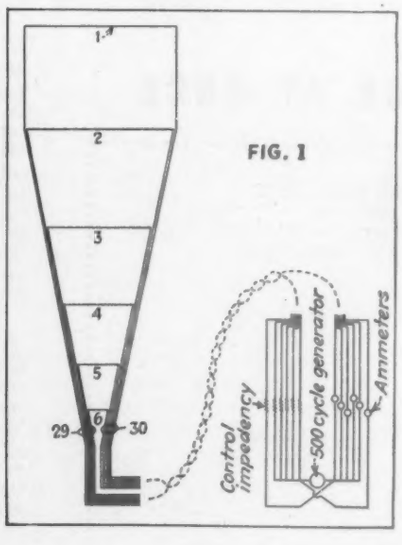
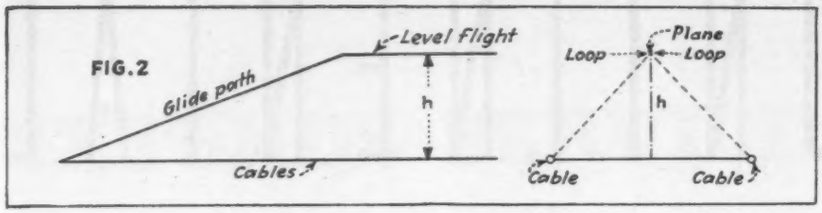


FIG. 1

In the aircraft, the output terminals of each loop are connected to individual audio amplifiers, each of which is tuned to five hundred cycles and the output of each amplifier is connected to a rectifier type a-c voltmeter having a range of 0–5 volts. The two voltmeters are mounted in a single case with their pivots in the lower left-hand and lower right-hand corners of the case, respectively, as shown in the front view of the instrument in Figure 3. The instrument is arranged so that at zero deflection both pointers will be vertical; so that at full scale deflection both pointers will be horizontal and so that at half scale deflection the two pointers will intersect at the center of the scale plate which point is marked by a bull's-eye.

The "glide path" is defined as that line in space (left, Figure 2) which has an altitude equal to half the horizontal distance between the two ground cables and which is parallel to and equidistant from the two ground cables. When the aircraft is flying normally along this glide path each



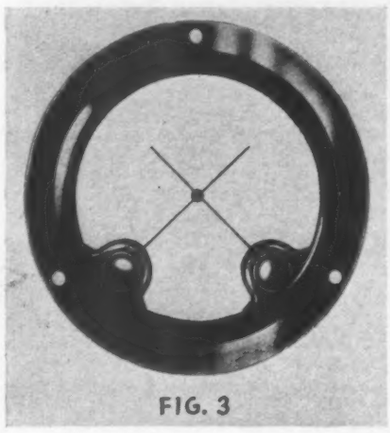
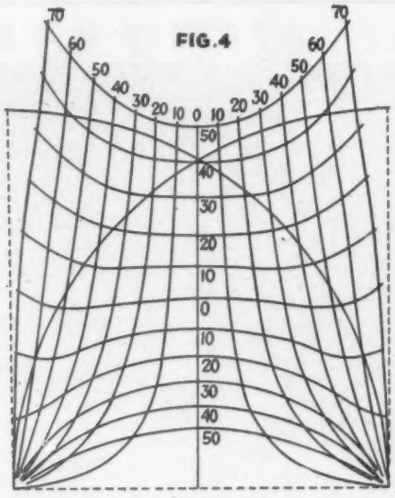


FIG. 3



the glide path. Figure 4 represents different intersections of the cross-pointer instrument. Each position of the crossed pointer is assumed when the aircraft is in the position relative to the glide path shown by the percentages marked on the diagram.

As thus far described, the glide path is horizontal. In order to cause the glide path to descend, it is necessary to reduce the strength of the magnetic field in the vertical plane mid-way between the two cables. Figure 1 illustrates the type of ground system now in use at Lakehurst, wherein the landing point is at the apex of the triangle formed by the two converging multiconductor cables. The 500-cycle generator is located at the airport as near the landing point as is desired but well clear of the landing areas. The generator supplies sufficient current through conductor 1 to produce a predetermined magnetic field at the altitude of the desired glide path in the area between conductors 1 and 2. The gen-

(*Turn to page 92*)

collector loop receives an optimum signal from one ground cable and no signal from the other ground cable. The currents in the two ground cables are identical because they flow in one continuous circuit and therefore the voltage induced in the two collector loops will be identical. When the output from the two amplifiers is sufficient to produce half scale deflection of the voltmeters the two pointers cross at the center of the scale plate of the instrument.

When the aircraft is flying parallel to the glide path but above it or below it or to the right or left of it, each collector loop which was previously receiving a given induced voltage from one cable and none from the other, will now receive another value of induced voltage from the one cable and an additional voltage from the other cable which voltage may aid or oppose the former depending on the position of the aircraft relative to the glide path. Since the amplification of each amplifier remains constant, the indications of the two voltmeters must therefore change in proportion to the collector loop voltages. This is best shown in Figure 4, which is a graph of the points of intersection of the two crossed pointers for various assumed positions of the aircraft with respect to the glide path. Tests conducted at Lakehurst indicate that tilting the wings 15 or 20 degrees or cross winds sufficient to cause a 15 degree "crab" do not noticeably affect the indication of the cross-pointer instrument.

The lines on this graph indicate departure from the glide path vertically or horizontally, and are marked in terms of percentage departure from

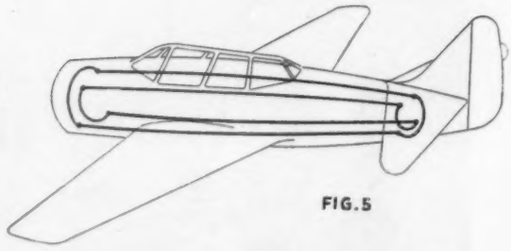


FIG.5

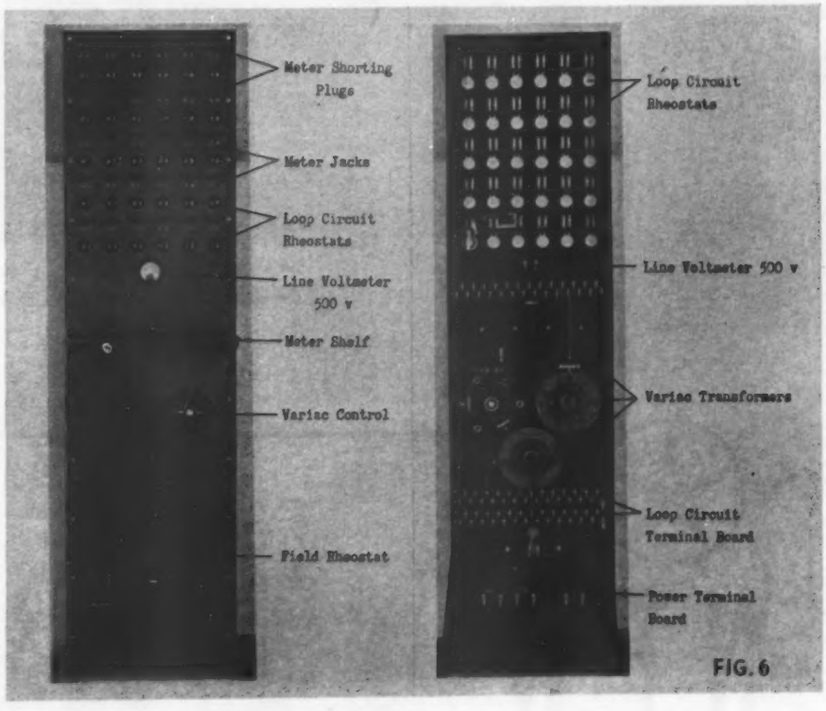


FIG. 6

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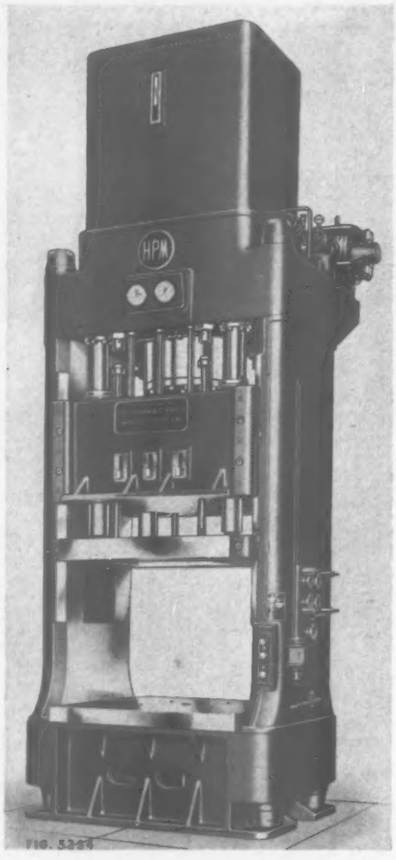
AIRPLANE OIL

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

A particularly versatile deep-drawing press has been developed by the Hydraulic Press Mfg. Co., of Mount Gilead, Ohio. Featuring "smooth-line" styling, and "Fastraverse" action, the new H-P-M press has all piping, wiring and control linkages concealed and all control stations and gauges flush mounted. The press embodies three separate hydraulic actions for operating respectively, the main draw punch, the blankholder ring, and the die bottom of the regulation triple action drawing die. An important feature is the ability to vary the pressure at each of the four corners of the blankholder, allowing the blank to be held more tightly at some points than at others for the drawing of difficult and irregular shapes.—AVIATION, *July, 1939.*



H-P-M Triple Action Press

Designed for aircraft maintenance work a line of socket wrench sets is offered by the J. H. Williams & Co., New York, covering nuts from ¼ in. to 1 in., with special attachments, drivers, and universal joints. Each set is supplied in a strong steel case.—AVIATION, *July, 1939.*

High altitude will not "pop" the stoppers in liquid containers packed in the new air-tight aluminum alloy traveling cases manufactured by the Metals Division of Erle P. Halliburton, Inc. All models are fitted with rubber seal gaskets to protect contents from moisture and dust. The stamped shells are heat treated to provide strength and finished in a natural Alumilite finish. Interiors of women's cases are done in silk with removable dress hangers, cosmetic and bottle pockets, and zipper-closing jewelry pocket.—AVIATION, *July, 1939.*

As aircraft factories continue to expand in size the need for parts handling trucks of specialized design becomes greater. Such a truck, of particular interest to aircraft manufacturers because of its small size and extreme maneuverability, is the "Stubby" gasoline powered fork type truck built in capacities of 2,000, 3,000, and 3,500 lb. by the Clark Tructractor Division of Clark Equipment Co., Battle Creek, Mich. The truck has a wheelbase of 38 in. and a turning radius of 67 in., which means that it can easily turn in intersecting aisles each 60 in. wide. The forks have a tiering height of 60 in. and the overall height of the machine is approximately 59 in., including the driver, who sits on top of the center of the machine with perfect vision in all directions.—AVIATION, *July, 1939.*

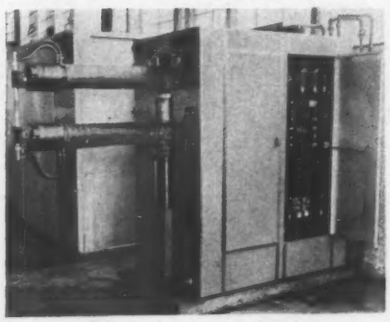
A new type convertible spot welder especially designed for welding aluminum, dural and stainless steels as used in the aircraft industry has been installed in the Ryan Aeronautical Company factory, San Diego, Calif. Known as the model 106, the welder is manufactured by Ralph S. Thacker, Harvey Machine Company, Los Angeles. The machine has a clear throat of 36 in. and a space between the arms of from 4 to 18 in. Welding capacity is two sheets of .125 dural. A set of rollers which replace the electrodes quickly convert the machine into a seam welder.—AVIATION, *July, 1939.*

A welcome machine tool innovation designed primarily for aircraft production work is offered by Fray-Mershon, Inc., of Glendale, Calif. The new tool is classed as a milling machine attachment, as it is operated on horizontal mills and immediately converts any horizontal mill into a full universal. Made in two types, it is offered with or without a 4 in. spindle travel. It is claimed that any milling machine operator can use this attachment without special training.—AVIATION, *July, 1939.*

Halliburton Cases

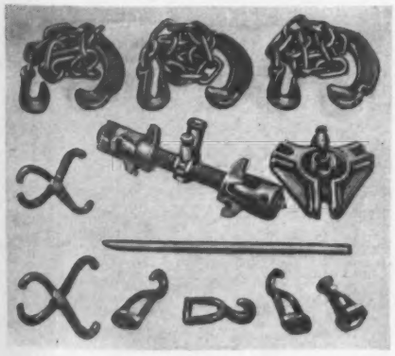
The new Windikator offered by General Communication Company, Boston, Mass., sounds like a useful little gadget, because it offers also a water-tight compartment for carrying matches, money, hunting, fishing and marriage licenses, etc. Aside from its use as a license container the Windikator also tells

Clark "Stubby"



Convertible Spot Welder

Windikator



Util-A-Tool Kit

accurately the speed and direction of the wind, model A measuring velocities of 5 to 30 m.p.h., and model B speeds of 10 to 60 m.p.h. We believe this should prove of real value to gliding and soaring groups, and also will have many applications in other fields of aviation. The unit is light and compact, total weight being less than two ounces, and the price is proportionately low. —AVIATION, *July, 1939.*

Looking somewhat like a Chinese puzzle, the Util-A-Tool kit is offered by Templeton, Kenly & Company, of Chicago, as the solution to a thousand and one puzzling problems around plant and hangar. Among the many possible applications are: spreading or pulling together structural members or any movable objects within its ten-ton capacity, pushing, hoisting, lifting, lowering, clamping, bracing, and tensioning. The Util-A-Tool also removes gears, wheels, pulley, and propellers. Five sizes are available, each in a compact metal box complete with instructions. The set includes appropriate jaws, clamps, chains and fittings for use with a special mechanical jack that operates either in tension or compression.—AVIATION, *July, 1939.*

As tooling continues to play a relatively more important part in the production of metal aircraft the development of tool and die making machinery has become vital to perfection of economical aircraft production methods. A particularly interesting machine for such work is the Hack multi-versal tool and die making machine perfected and patented by the Hack Machine Company, Chicago, Ill. This machine serves also as a short run production machine for quick set ups. Operations for which it is designed include jig boring, vertical and horizontal milling, contour milling, slotting, filing, drilling, grinding, broaching, and sawing. Changes from one attachment to another are easily made by one man.—AVIATION, *July, 1939.*

Designed to solve the many maintenance problems involving applications of more than normal man-power to pulling, pushing, clamping, spreading, and bending operations, the "Porto-Power" hydraulic ram device has been developed by the Black-Hawk Mfg. Co. of Milwaukee, Wis. This equipment consists of a 10-ton remotely controlled hydraulic unit, special attachments, and a press, all mounted on a portable stand that can be rolled anywhere in the shop or hangar. The hydraulic unit consists of a hand-operated pump separated from the ram by a six-foot high pressure hose, enabling the ram to be operated in any direction. The press is sufficiently wide to straighten bent propellers, extensions are available to convert the ram into a jack for lifting a wing into place, and other combinations of the equipment are readily made to fit the requirements of any job.—AVIATION, *July, 1939.*

In keeping with the maintenance theme of this issue of AVIATION, we are pleased to note a strong flavor of maintenance items among the many current trade catalogs which have come to our attention, and of which we offer the following for your consideration. Please write direct to the firms listed:

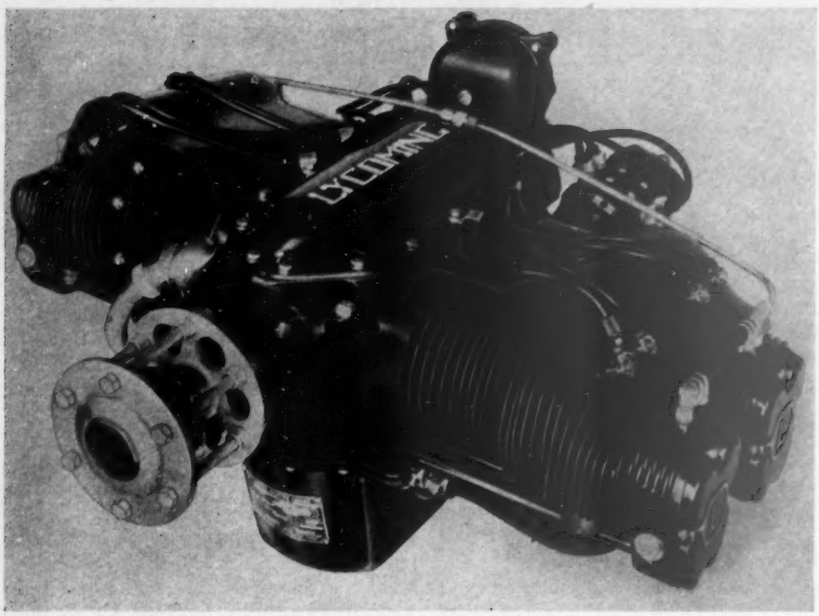
AMERICAN SEAMLESS FLEXIBLE METAL TUBING—A 24-page liberally illustrated manual and catalog of flexible tubing available for aircraft requirements. The American Brass Co., Waterbury, Conn.

THE PRINCIPLES OF VALVE RECONDITIONING—An invaluable reference work for the maintenance shop, dealing with valve maintenance in 22 pages of well illustrated and graphically presented valve system maintenance information. The Black & Decker Mfg. Co., Towson, Md.

ENGLE AIRCRAFT SPECIALTIES—A 32-page illustrated catalog of the complete line of Engle aircraft specialties, which consists of cowlings, speed rings, deflectors, manifolds, spinners, wheels, and many other special items manufactured from sheet aluminum or steel alloys. Engle Aircraft Specialties, Escondido, Calif.

FAFNIR BALL AND ROLLER BEARINGS FOR AIRCRAFT—An 8-page illustrated folder containing tables of dimensions and load capacities of Fafnir bearings and other information of special interest to aircraft designers and maintenance men. The Fafnir Bearing Co., New Britain, Conn.

PARKER-KALON SOCKET SCREW DRAFTING ROOM CHART—This interesting device is a circular reference chart giving full information on diameter, length and threads per inch of a wide range of socket cap screws, set screws, and socket head stripper bolts. Parker-Kalon Corporation, 200 Varick St., New York, N. Y.



Lycoming 65

Manufacturer rates engine approved for 75 hp. at lower output for the present.

CONSTRUCTION and design details of the Lycoming Model 0-145-B engine, announced in AVIATION for June, 1939, are now released by the Aviation Manufacturing Co. Although it is rated at 65 hp. (2550 r.p.m.) the new engine develops 75 hp. at 3100 r.p.m. The 75 hp. rating is approved under ATC No. 210. Cruising power of 47 hp. is available at 2300 r.p.m. using 73 octane fuel. Weight with single ignition is 155 hp. Fuel consumption is 5½ gal. per hr. at full throttle and 3¾ gal. per hr. at cruising.

The integral crankcase and cylinder block is split vertically through the center with a ground metal to metal joint and bolted together with through bolts as in the 50 hp. engine. Four mounting bosses are cast integral with the crankcase sections providing a platform type mounting. Main and connecting rod bearings are the precision type replaceable steel back copper lead lined bearings.

The lubrication system provides automatic valve gear lubrication and features a gear type pressure oil pump driven from the crankshaft. Oil is forced through the camshaft to all cam bearings, crankshaft main bearings and connecting rod bearings. Crankshaft is bored to provide centrifugal sludge removers at all passages leading to the main bearings. Pistons and piston pins are lubricated by splash. A screen oil baffle is provided between the main crankcase sections and the oil pan.

The crankshaft is a one-piece forged steel alloy nitrided type with four throws and three main bearings. Each crankshaft is statically and dynamically balanced. The rear propeller flange is forged integral with the shaft.

The camshaft is a heat treated forging with hardened lobes and drilled for lightness and to provide oil passages. Mushroom type steel cam followers with hardened faces and sockets operate directly in the crankcase section. Push rods are steel tubing with hardened ball ends. Forged steel rocker arms are supported on full floating pins in the cylinder head and secured in place by means of end plugs.

Material of intake valves in chrome nickel steel and exhaust valves is austenitic steel. Aluminum bronze valve seats are rolled in the head. Valve guides are of phosphorus bronze. Valves may be adjusted by means of the screw and locknut adjustment provided in the rocker arms.

Forged steel split cap type connecting rods employing bronze bushings in the small end and precision replaceable copper lead lined bearings in the crank pin end are used.

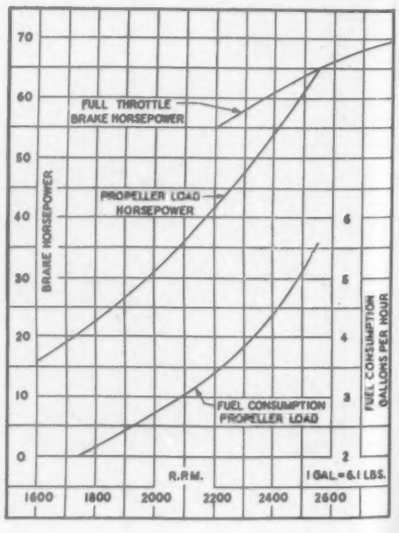
Pistons are cast Lo-Ex aluminum alloy and are machined with four ring grooves; two compression rings, one oil regulating ring and one oil scraper ring. Full floating type piston pins are used with aluminum alloy plugs inserted in each end. The use of the aluminum pistons operating in the cast semi-steel heat treated cylinder bores provides excellent bearing surfaces which eliminate scuffing of pistons and rings.

Equipment includes a Bendix-Stromberg type NAS2 carburetor. Excellent distribution of the fuel-air mixture to each cylinder intake port is obtained by the center-zone induction system which is cast directly in the oil pan. Each cylinder has a separate interchangeable intake pipe. By passing through the oil pan the mixture is kept at a more uniform temperature permitting the engine to respond rapidly to full throttle after long glides. The Scintilla SF4L magneto is standard equipment.

Overall dimensions of the Model 0-145-B1, which is equipped with single ignition, are as follows: overall width 29.56 inches, overall height 20.12 inches and overall length 23.75 inches.

Specifications are as follows:

Rating at sea level..65 hp. at 2550 r.p.m.
Cruising rating....47 hp. at 2300 r.p.m.
Bore and stroke.....3⅜ x 3½
Displacement .....144-5 cu. in.
Compression ratio 6.5:1
Weight (Single Ignition).....155 lb.



THE AVIATION NEWS

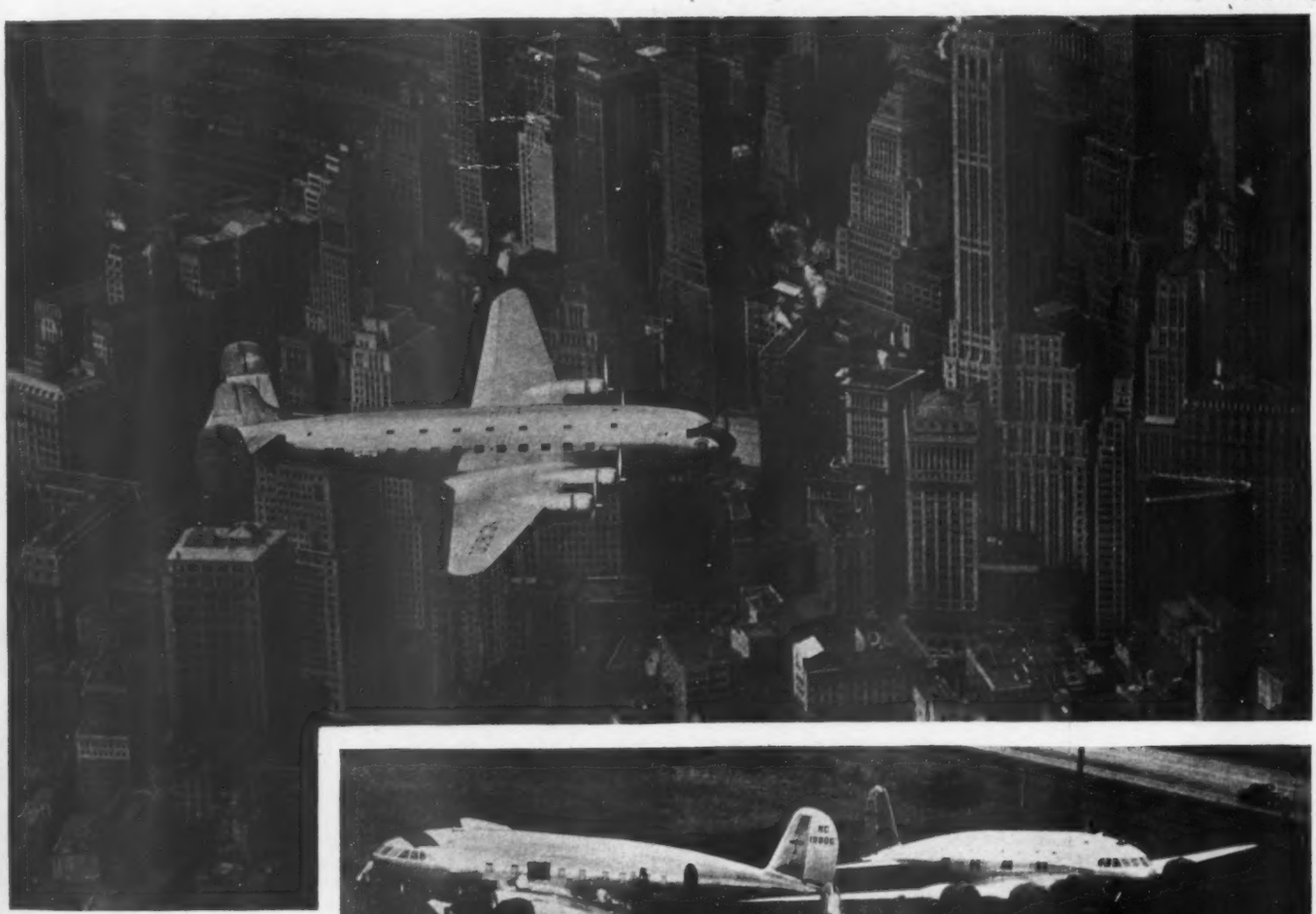
REVIEW, COMMENT, FORECAST

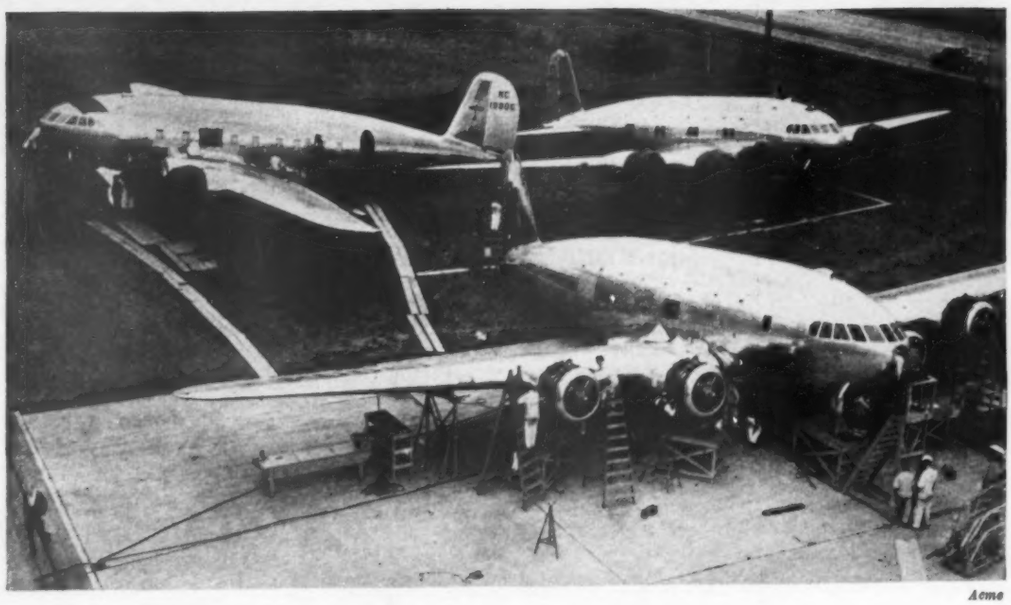
DANIEL SAYRE
C. F. McReynolds, *Pacific Coast*
Blaine Stubblefield, *Washington*
E. R. Lockin, *New York*

JULY 1939

United A. L. Wins AVIATION Award

(Story on page 68)





FOUR TIMES FOUR: The Douglas DC-4 (above) poses for that New York Skyline picture at the end of its maiden transcontinental trip. At least half a million people turned out for a first-hand inspection of this "largest land plane ever built in America" as it moved across the country in service tests as the "Super-Mainliner" of United's airline fleet. At right, three Boeing Stratoliners are moved outdoors. Meanwhile, Stratoliner No. 2 is being put through exhaustive flight tests (Story on page 84).

Acme

NATIONAL AVIATION

U.A.L. Wins AVIATION'S Maintenance Award

Presentation climaxes Conference at Los Angeles

The Airline Engineering and Maintenance Conference of the Air-Transport Association held one of its most interesting and successful meetings at the Town House, Los Angeles on June 12, 13 and 14. Centered as it was in the midst of California's booming aircraft industry, the conferees reported that they gained almost as much from contacts and inspection trips outside as they did in the 2½-day program of meetings.

After a few opening comments by William Littlewood of American Airlines, serving as chairman of the conference, Robert Gross of Lockheed Aircraft set the ball rolling on Monday morning with a talk on "Air Transport Problems as the Aircraft Manufacturer Sees Them." He was followed by H. E. W. Tinker of Douglas Aircraft speaking on "Coordinating Operators Requirements with Transport Design and Maintenance." After luncheon the conference went into session with one of its customary item-by-item discussions of engines and engine accessories. Tuesday the conference worked through a long list of topics on instruments, aircraft maintenance and miscellaneous subjects. Wednesday morning the meeting finished up with consideration of general problems of interest to maintenance men such as standards, reports, C.A.A. inspections, etc.

High-lighting the Dutch-Treat Dinner on Tuesday evening was the presentation by S. Paul Johnston, editor of AVIATION to United Airlines of this magazine's annual maintenance award. Presented annually "in recognition of outstanding contribution to the field of maintenance of equipment in Air Transportation," the award in 1937 was awarded to William A. Hamilton of TWA, in 1938 to H. D. Ingalls of American Airlines. This year a modification of rules governing the award of the plaque put the selection of the winner on an air-line rather than a personal basis. The selection of United Airlines as this year's winner met with wide and generous approval by maintenance men attending the conference.

Headline speaker of the Tuesday night dinner was Harry Stuhldreher once a member of Knute Rockne's famous four horsemen of Notre Dame and at present a football coach at the University of Wisconsin.

International

THE SOARING SEASON — is upon us. Early last month Woodbridge Brown, above, flew his Bowlus sailplane from Wichita, Texas to Wichita, Kansas, set two marks—289 miles; 7,600 ft. Then Ted Bellak, hopped across Lake Michigan. Moral—don't miss that Elmira meet, June 24-July 9.

Triumph and Tragedy

Sarabia's death a sad blow to two nations

Outstanding triumph, then stark tragedy fell to the lot of our flying friends South of the Rio Grande last month as Francisco Sarabia first shattered the Mexico City-New York record, then met death as his plane crashed into the Potomac River just after take-off from Bolling Field, Md.

Few record flights within recent years were more dramatically brilliant than Sarabia's flight northward. Flying the Gee Bee racer "Q.E.D." which had been originally built for Jacqueline Cochran to use in the MacRobertson race, Sarabia took off from the high upland airport near Mexico City with some 525 gal. of fuel, at dawn May 24. For 2,350 miles he flew high, pushing his stubby racer near it's 1,000 rated hp. in the face of widespread storms. At 6:40 p.m. (EDT), just after a false report that he had been forced down near Atlanta, Ga., Sarabia appeared over Floyd Bennett Field, Brooklyn. With his fuel gages hard-up against the empty mark, the dynamic little flier, who had created and operated Mexico's biggest domestic airline, did not dare risk even a preliminary circle of the field. Instead he headed straight in for a landing with a moderate wind directly on his tail. In spite

Arnold

FRANCISCO SARABIA
Death cut short his triumph

of his speed of at least 120 m.p.h. his contact and roll were as neatly tree-pointed and smooth as a pilot ever made. His time of 10 hours and 37 minutes beat the old Earhart mark by almost four hours.

A big throng of his countrymen and a large group of American airmen showered congratulations on the flier. For a week he was properly lionized as the hero of the opening of Mexico's pavilion at the New York World's Fair. Then the newly crowned "Lindbergh of Mexico" flew his racer to Washington where he received the congratulations of President Roosevelt and of high-ranking American Air Officials. Then June 7, Sarabia climbed into his plane for what was to have been a non-stop flight to his Mother's home at Lerdo, Durango, Mexico. Once more with his tanks crammed full of fuel, he lifted the Q.E.D. off the long runway of Bolling Field. Something went wrong. Possibly the engine for a few seconds failed to deliver its full horsepower; Possibly the heavily loaded plane (field men estimated the plane's wing loading at take-off at 78 lb. per sq.ft.) struck a gust or a down draft of air. In any case, quicker than words can describe it, the racer dropped from a height of about 50 ft. into the Potomac. By the time frantic rescuers could reach him, Sarabia had died, apparently from drowning.

Mexico was stunned. Someone started the rumor of sabotage. A crowd of hysterical students stoned the American School in Mexico City, then were only prevented from attacking the American Embassy, by police intervention. Mexico's Ambassador to the United States and Mexico's Foreign Minister hastened to assure America and the Mexican public that the charges were ridiculous and completely unfounded. The U.S. Army Air Corps dispatched its big "Super-Fortress" Boeing Bomber to Mexico City carrying Sarabia's remains and renewed expressions of sympathy from President Roosevelt to President Cardenas and to the Mexican people. The funeral in Mexico City was one of the largest and most impressive ever accorded a citizen of Mexico. It was deservedly so.

Air Fair Packs 'Em In

20,000 per day visit Aviation Building at New York Fair Grounds

"A smash hit from the day it opened" is the way the New York *World-Telegram* describes the aviation exhibit at the New York World's Fair. If it's possible to add anything to such a tribute, we hereby give our own opinion that the exhibit is not only a smash hit from an attendance point of view (approximately 20,000 a day have been piling into the building in recent weeks) but that this particular show is going to do more good for the aeronautical industry than any previous effort along similar lines during the past two decades.

May 20, the opening ceremonies developed into a spectacular kick-off for the project. Seemingly the mere fact that the day had been designated as Aviation Day was enough to attract a throng of 232,426 customers through the Fair's turnstiles, the largest attendance on

any Saturday since the opening on April 30. Break of the day was the fact that Pan American Airway's that afternoon dispatched the inaugural air mail flight of its new trans-Atlantic service from nearby Port Washington. A few minutes after take-off the big four motored Atlantic Clipper circled low over the Aviation building where the dedication ceremonies were in progress. Through a public address system the big crowd assembled was able to hear all of a two-way conversation between Captain A. E. La Porte and Chairman Robert Hinckley of the CAA. Captain La Porte sent greetings to Captain Towers, veteran of the NC Trans-Atlantic flight of 1919 who was attending the dedication. Then as the Clipper moved away Captain La Porte said "Everything is fine. We are ready to go on. We are now about to proceed to Europe." Mr. Hinckley, visibly moved, replied "Proceed to Europe, Captain La Porte. Proceed to Europe with the mail!"

Thomas Morgan, chairman of the Advisory Committee on Aviation for the Fair had previously begun the dedication ceremonies by pointing to the building and its contents as a tangible proof of the interest and unity of the aviation industry throughout this joint enterprise.

"American airplanes have conquered the mighty Pacific," Mr. Hinckley said, "Luxurious and efficient American airplanes travel over a network of airlines in South America and in our country. In this connection let me report with pride that the last 65 million passenger-miles flown by these domestic airlines represent a perfect safety record, not a single casualty."

Major General Delos C. Emmons, Commander of General Headquarters Air Force, spoke on military aviation in the light of the President's Expansion Program.

Mr. Morgan then introduced Captain Towers, U.S.N. Captain Towers recalled the Navy transatlantic flights, but passed over them briefly before congratulating the industry on the building and its exhibits.

Colonel Edgar S. Gorrell, president of the Air Transport Association, was the next speaker. He praised the work of the Civil Aeronautics Authority in aiding air transport and in interesting banks and insurance companies in giving financial support to airlines.

Grover Whalen, president of the New York World's Fair, commented on the important part aviation would play in the World of Tomorrow. He was followed by Representative Melvin Maas, of Minnesota and Fiorello H. LaGuardia, who concluded, "The Fair is the first thing that has happened in this world that challenges description in any language. And aviation is one of America's greatest contributions to civilization today and to the world of tomorrow."

At the close of the Mayor's remarks, the speakers walked to the entrance of the building where Colonel Gorrell cut a ribbon to symbolize its official opening.

MORGAN, WHALEN, HINCKLEY, GORRELL, LAGUARDIA
Col. Gorrell cuts into a good thing.

THE WASHINGTON WINDSOCK

by BLAINE STUBBLEFIELD

Low Ceiling Forecast For Route Extensions

Mail System Expansion at last is up for formal treatment but the die is already cast. Congressmen will resist community-pride pressure except where *new* poundage or genuine commercial need can be shown, and that is hard to do. Post Office cannot promise mail unless it can get appropriations from Congress. Recent action on the Hill answers that one. Even if CAA would issue certificate without promise of mail, such certificates would be worthless. The old national defense argument will be worked to the limit, without much avail. Expect to see only a few new routes. Meanwhile, improvement in existing system, more frequent deliveries, is the watchword.

When Lindbergh told the War Department that research was more important than a sky full of airplanes, so many congressmen agreed with him that for a time it seemed that appropriations to build authorized expansion airplanes would be delayed. But actually, not one wheel in the whole new defense program could ever have been stalled or even slowed down; public opinion horsepower was irresistible.

All Dirigibles Down. The art is deader than ever since the French launched originals in the 1850s. Ickes prevented helium sales to Germany because she might turn it to military use. Then our own Army and Navy dropped the art cold, saying it has no military value. The Stubblefield award goes to the Government this month for this colossal contradiction. Now President Roosevelt throws a fit because Goodyear submits an alternative bid and he pigeonholes his authorization from Congress to build a ship. Only hope of balloonatics is that F.D.R. will change his mind or Congress will overrule him.

War Department played 'possum with the Hill bill to set up what amounted to another Wright Field, plus a federal "yardstick" airplane plant. Louis Johnson had promised airplane manufacturers vaguely there would be no yardstick. The Department regards it as unnecessary in view of rigid inspection and profit ceiling, called it a log-rolling maneuver. But Senator Hill lured support with such bait as aviation research, pilot training, metallurgical study—things a lot of people want.

G-Travel is on the up since airlines got two concessions: (1) modification of the Roosevelt order so that government employees may fly and get their department head's approval afterward, and (2) an order from CAA giving them the regular 15 per cent travel card discount. Most lines are pleased but regard status as temporary, until final outcome of the commercial travel discount investigation.

SPARE PARTS: Congressmen gasped at DC-4, visiting here; so did old flyers; it accelerates so mightily on the ground you stick to the chair back. . . Stand there long enough and you'll see every notable in aviation—not at Fifth and 42d but at Fourteenth and Pennsylvania. . . . Chronic air line spongers and turnstile crashers are still trying to work out a dead-head scheme. . . Don't think that reorganization of CAA is dead; it's now in the hotel room stage of incubation. . . . United Air Lines' research plane here took aviation writers on demonstration of radio teletype receiver; we talked to the station in Baltimore and it typewrote right back at us; present range: 150 miles. . . . State and War Departments don't like Germany's purchase of big airport in Bolivia, but they can't do anything about it. . . . Army and Navy are increasingly interested in liquid-cooled engines.

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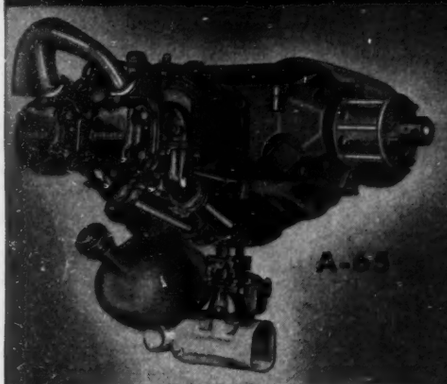

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DEFENSE

Funds For Defense

Congress nears end of bills affecting air services

By Blaine Stubblefield

Washington's swivel-chair national defense army is mopping up the last straggling bills on Capitol Hill. In next issue we can pretty accurately add up the aviation items in the two-billion-dollar "white war," as Europe is calling its armament derby.

The last big-league play in the defense line-up was the Navy's 1940 supply appropriation of $773,049,151 for all purposes, which is $149,522,957 more than the 1939 figure. For Naval aircraft Congress allows $88,298,000, including $5,000,000 contract authority.

Detail of items of the Navy money was given in last issue. It is estimated that 500 new airplanes can be procured with the appropriation, bringing the total to 2,132, which is 83 more than the old objective before last year's expansion act, but still 868 short of the 3,000 minimum strength set in that act.

Next in magnitude comes the famous 300-odd million dollars for Air Corps expansion to 6,000 airplanes, educational orders, and Canal improvements. This item had a rough time for a few days, account of Mr. Lindbergh intimating we might not need so many airplanes. But that didn't bother anybody very long. The bill has been placed before the House — minus, of course, the $50,000,000 already spent.

The $25,000,000 bill introduced by Sen. Lister Hill of Alabama to establish a "military aircraft engineering center" had so many come-ons in it that even the War Department chased the lure around the Hill, though it didn't come out openly for the "yardstick" aircraft plant, bare mention of which makes manufacturers groan with pain. Some of the bait that won support, even after the Administration had sort of promised there would be no yardsticks in aviation, were such as provision for pilot training, metallurgical research, aerodynamic research, in fact most everything that, if you put it all together, would spell another Wright Field, plus the yardstick plant. Another thing was the testimony of a Washington engineer named Willis G. Waldo, who blew hats off with startling statistics.

Lying dormant in the House Military Affairs Committee, though passed by the Senate, is a bill authorizing the War Department to negotiate for certain supplies and equipment without regard to the bidding system.

Civil pilot training was reported to the Senate at the same figure which was in the bill passed by the House: $5,650,000. The Senate committee recommended that a $7,000,000 ceiling be placed over annual expenditures in the future.

Some odds and ends are being picked up in the third deficiency bill. For instance, the initial appropriation for procurement under the new $100,000,000 strategic and critical minerals authorization will be included. So will the supplemental estimate for the Post Office to pay for air mail carriage on new routes. If Congress still takes a notion to authorize more research facilities for NACA, which it well may, the appropriation for same will be in it.

Air Corps Contracts

Late in May the War Department completed the placement of contracts allocating the $50,000,000 appropriated by Congress to get the Air Corps enlargement program underway. Approximately $15,000,000 went for a contract with the Douglas Aircraft Company for an undisclosed number of attack bombers.

Also ordered: two attack bombers each from the Glenn L. Martin Company and the Stearman Aircraft Company at a cost of about $500,000 for each pair.

A few days later the War Department further announced a contract for $974,324 worth of Seversky pursuit planes.

June 15, came word of contracts for observation planes—$1,500,000 to Stinson; $50,000 to Bellanca; $50,000 to Ryan.

Air Corps Birthday

U.S. Army aviation will be exactly thirty years old on August 2, the anniversary of the purchase in 1909 of its first Wright biplane. Plans for the observance are still nebulous but each Air Corps base will probably hold Open House for the public and stage some sort of flying program on that day. Fittingly enough, the most elaborate observance of the anniversary will be made at Wright Field, Dayton.

AVIATION ABROAD

British Wings Grow Stronger

Worries over numbers give way to concern on quality. Recruiting effective.

The British are getting quite cocky over their production figures. No official data that mean anything have been put out—it's always in the form that production now is 305 per cent greater than it was sometime else—but the general impression has got around that it's now up even with Germany's or a little better. The story most heard is that in the spring of 1938 the rate was about 150 ships a month, which shot up fast to 600 or so a month by winter as the shadow factories really began to roll them out. Right now, according to this dope, the rate is between 750 and 1,000 a month. The same story has the Germans doing about 700 a month last fall, a figure that's supposed to have gone up some but not much since then. Another thing that's cheered the British was the Air Ministry's estimate that in case of war the output could be pushed up without much trouble to the 35,000 to 40,000 a year considered necessary. No details as to how this wonder was to be worked or how many years of war it would take were given.

Pilot Problem

Producing pilots has been as big a problem as getting out the ships for them, and the British have now got their recruiting and training organization pretty well set to pull in everyone possible. That it's working is shown by the fact that the intake into the R.A.F. has been sticking around the 1,000 per week mark for some time. The first line is of course the R.A.F. proper, which is taking in all the officers it can get on both permanent and short-service commissions, plus all the other ranks needed to make an air force. One result of the expansion program is that all primary training for the R.A.F. has been turned over to the regular civilian flying schools, which bring the pilots up to the "A" license stage before they go on to R.A.F. schools for advanced instruction. This whole training period takes about ten months. Those who come in under short-service commissions serve four or six years full time active duty with the R.A.F. and then are transferred to the R.A.F. Reserve, in which they have to do enough flying to keep their hands in for the rest of their ten-year term.

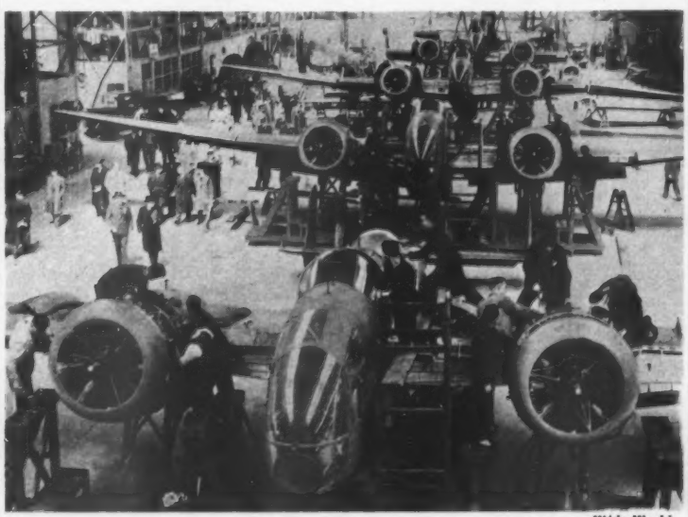
Two years ago the R.A.F. Volunteer Reserve was set up to draw those who could meet the regular R.A.F. physical standards and were interested in flying, but who for lack of money or ambition had never had instruction and who did not want to join up even for a short-service term in the R.A.F. These reservists are given free training in their spare time at a number of training centers scattered around the country. Instruction at these centers is also given by private operators under contract. Their training goes on up to handling military ships, mostly obsolescent hand-me-downs from the R.A.F. They also get periods of active duty in regular R.A.F. squadrons. At present there are about 3,000 of these Volunteer Reservists, the number having been upped recently by taking on observers and other types beside aviation pilots.

The R.A.F. Reserve and the Volunteer Reserve are strictly reserve organizations meant to fill in the holes in the R.A.F. and form new squadrons in wartime. In addition to them is the Auxiliary Air Force, which corresponds fairly well with the National Guard in the U.S. It is organized into squadrons—mostly fighter—equipped with first-line planes, and is supposed to be ready to go into action at once. At the bottom of the list is the Civil Air Guard, organized to give elementary training at the flying clubs practically free to all comers. It's too early yet to tell how valuable it will be, but a lot have gone from it into the R.A.F. and Volunteer Reserve who might never have come out without the ballyhoo that went with the C.A.G.

How good are they?

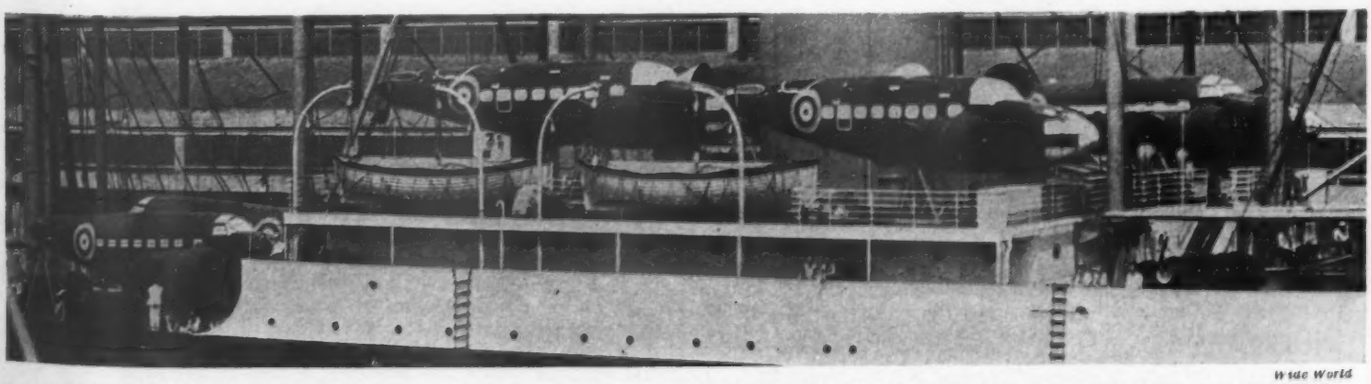
One thing that's caused a lot of British worry even with the production curve shooting up has been the fear that too much attention was being given to turning out near-obsolescent planes by the thousand and not enough to developing new ships to follow along through the production lines. Several models have just been publicly unveiled, which while they aren't super astonishing at least show that the designers are still on the job.

One of them is the Bristol Beaufort, to be supplied in both general reconnaissance and torpedo bomber types. It looks very much like a slightly larger Blenheim, but the Bristol boys get very hurt when anyone says so since they claim it's all new. Its two 1,065 Bristol Taurus double row sleeve valve engines are supposed to give it a little more speed than the Blenheim, which would mean somewhat over 300 m.p.h. Be-



Wide World

HOME MADE: Handley Page "Hampden" twin-engine bombers move along a bustling assembly line at the big Radlett plant in England.



Wide World

YANKEE GOODS: The British motor ship Lochavon loads up at Los Angeles Harbor with 23 Lockheed bombers for the R.A.F. A half dozen of the fuselages are shown here stowed as deckload. Lockheed is now rolling out more than one a day.

AS OTHERS FLY IT

High Pressure Training Piles Up Casualties

An Atlantic mail rate war may be in the making now that enough progress has been made on the technical end of the route to leave some time for thinking about economics. The French, who take just about the same stand as the U.S., expect their transatlantic line to run pretty much as a business proposition. Their idea of a proper mail surcharge is one high enough to allow the line to make a little money once traffic gets well established without bleeding the treasury too much. They've followed that system on their South Atlantic route, charging 48 cents postage on a letter weighing 1/6 of 1 oz., which in the last few years has put that line fairly well on the way toward paying for itself. On the North Atlantic they'd like to see a rate of around 25 cents or more per ½ oz., which ties in pretty well with U.S. ideas. To the British, however, the route is more than just another airline—it's one of the last links in a system of empire communications. While they don't expect in the near future to apply the Empire scheme of carrying the mail without surcharge on this route, they would like a rate about half what the French and Americans think proper. It looks as if they'll string along with the higher rate for the present, but there'll be a lot of hollering in England over paying close to ten times as much to send a letter to Canada as to send it half way round the world to New Zealand.

Official secrecy on military accident figures, which has been clamped on almost everywhere now, has made guessing them the most popular game since "Guess How Many Ships The Germans Have." If the brass hats thought they were going to ease the public's mind by keeping the lid on they were badly fooled. There's no doubt the number has got up pretty high in places, but so far only Britain has made its record public to cut down on rumors. This year the British have been losing about 25 men a month, which the Air Ministry claims is no worse per hour flown than in preceding years. Although there is no official dope out, the German rate may be about twice as great, with the French and Italians running somewhere near the British.

The big German boat which everyone has been sure was underway somewhere turns out to be a six-engined one to gross around 40 to 45 tons being built by Blohm and Voss. It's due out early in 1940 and is designed for mail and passengers direct from Portugal to New York. . . . The five Liore and Olivier 47 boats which were due to start a French South Atlantic passenger service this summer are finally out and flying. By the end of the year they're expected to replace the Farman landplanes which have been hauling mail only. They aren't very large as boats go nowadays, weighing only 17 tons, but they are expected to cruise at 186 m.p.h. with a ton payload on the Africa-Brazil run, meaning a ten-hour crossing. The Ville de Saint Pierre, the 44 ton Latecoere boat that is pretty much a cleaned up brother of the ancient Lt. de Vaisseau Paris, is also out going through its acceptance tests for Air France Transatlantique. It will probably do some North Atlantic surveying later this year. . . . The British boat situation hasn't changed much since last month. Refuelling tests with the Atlantic super-Empire boats showed that their plumbing needed some changes, and the big G class boats aren't ready by a long way. There are stories in England that the British won't do anything on the North Atlantic this year, as the pessimists figure that by the time the ships are ready Newfoundland will be frozen up solid.

A new propeller by Fairey was the big hit of the Royal Aeronautical Society garden party at which it made its first bow. It's made up of two oppositely rotating coaxial three-bladed props, which isn't exactly new, but the fact that it's a constant speed type with full feathering blades really makes it quite a piece of machinery.

side going into production in England, this is the ship the Australians are scheduled to build for their own air force and for export to other parts of the empire.

Another new job is the Boulton Paul two-seat Defiant fighter, pulled by a Rolls Royce Merlin at a speed said to be up in the single-seat fighter class. It has a power-operated turret which is supposed to mount a battery of machine guns. Some effort has been made in this ship to fair the turret into the rest of the works but even so it must cause a lot of disturbance.

On turrets

The British still love their turrets, and claim that tests at the armament experiment station at Martlesham Heath show them to be fine. They certainly have the courage of their convictions, for they cluttered up the roofs of their Lockheed Hudsons with domes that would have done credit to a good sized observatory. Power-driven nose turrets, with all the gadgets and chances of bugs that go with them, were stuck on most British bombers a few years ago, but the nose turrets have come off all but the very heavy bombers in favor of fixed guns firing forward and turrets back of the wing, the turrets being powered on recent ships. The French haven't gone in for turrets of any kind much lately, being pretty well convinced that guns firing at much of an angle to the line of flight are no good anyway.

The British have taken over one armament idea pioneered by the French, though. They are now turning out Hispano Suiza shell guns under license, and there's great speculation as to whether they'll go in the Spitfires and Hurricanes or into something newer and finer. Dunlop Rubber has shown off a hydraulic system for cocking the shell gun and firing it along with two machine guns, the gun control being interlocked with the hydraulic system for retracting the landing gear so that the guns cannot be fired unless the wheels are up.

In spite of these signs of design activity a lot of members of Parliament kept right on worrying, so finally the Air Ministry invited some out to the R.A.F. base at Northolt, where they were reassured by a glimpse of two hush-hush ships that according to reports went over the field so fast that nobody got much of an idea of what they looked like. One was a monoplane fighter with two radial engines which the M.P.s were assured was faster even than a Spitfire, the highest praise an Englishman can give.

Just what they were is an official mystery, but there are several new prototypes known to be somewhere along the way. One is a twin-engined fighter designed by Westland rumored to do 430 m.p.h. and very unconventional indeed if some reports are correct. Martin Baker, a newcomer, is also building a single-engined fighter of trick design, probably taking a Napier engine. Then there's the super big landplane bomber from Short Bros. that folded its undercarriage while taxying after a test hop a little while ago. Taking them all together, it's probable the English are going to burst out with a lot of noise and uncover a new crop of military ships before long.

D.L.H. Traffic Drops

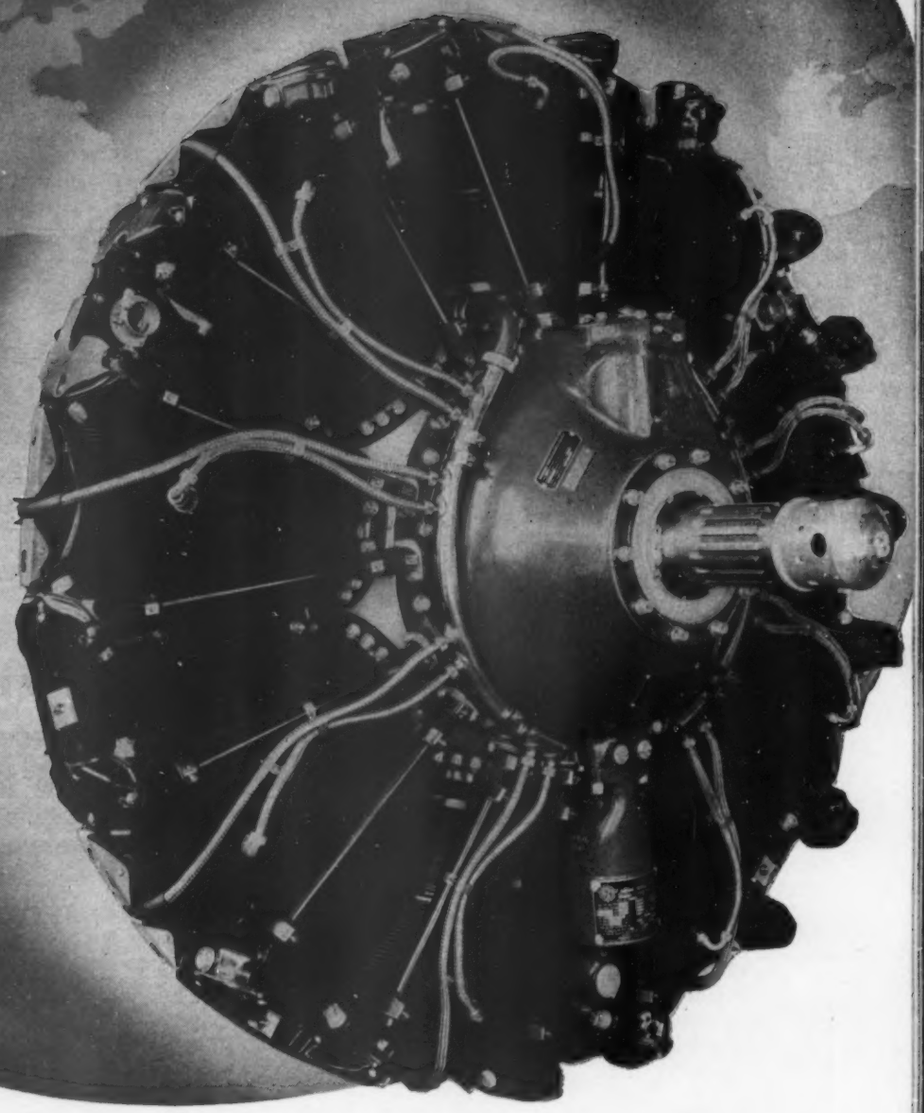
Deutsche Lufthansa's traffic figures for 1938 make strange reading, for they show in many cases decreases from 1937 results. On European and domestic lines, in spite of a 5 per cent increase in miles flown to 11,000,000, passenger-miles decreased 1 per cent to 63,000,000. Passengers were off 8 per cent to 255,000. Mail ton miles, however, were up almost 80 per cent to 1,625,000. On lines outside Europe the results were about the same. The line to South America flew around 625,000 miles, about the same as before, but routes in South America increased their flight mileage 24 per cent to 1,700,000. Passengers on these lines also fell in spite of increased service, dropping 10 per cent to 14,000, while mail increased slightly.

K.L.M. In Steady Climb

Statistics from K.L.M. are a lot happier, showing passengers up 36 per cent, express up 41 per cent, and mail up 29 per cent from 1937 to 1938. Figures for the first quarter of 1939 show a continued rise over the same period in 1938; passengers have increased 67 per cent, express 31 per cent, and mail 34 per cent. Four Douglas DC-5s are on order for internal and European runs, but on new equipment for the Batavia line there's been no decision announced yet. One hump that looked as if it might prevent the sale of DC-4s has been got over; the Dutch exchange control has given K.L.M. permission to buy up to six if they wish. This summer K.L.M. will extend up to Oslo in pool with the Norwegian line D.N.L. This is a step in the direction of an Iceland line, in which K.L.M. and D.N.L. are both interested.

1200 H.P.

the G-200 WRIGHT CYCLONE



. . . Now

AVAILABLE FOR SALE THROUGHOUT THE WORLD

The latest series of the famous Wright Cyclone single-row, radial aircraft engines is now available for general domestic and export sale. Models of the G-200 Series develop 1200 H.P. for take-off, and all are available with either single or two speed superchargers to give optimum performance for all altitude requirements. The G-200 Series Cyclone represents the next logical step in the development of the outstanding Cyclone type.

Over nine thousand Wright Cyclones have preceded the building of the G-200 Series—a record unapproached by any other engine in the high horsepower class. These engines have proven their reliability by years of gruelling commercial and military operations. In commercial operations alone during the past five years, Cyclones have logged a total of well over 2,500,000 flight hours.

Second only in importance to reliability—the initial cost of the G-200 Cyclone is less per horsepower than that of any other aircraft engine of comparable power manufactured today, and the simplicity of its construction makes for further economy in maintenance.

WRIGHT AERONAUTICAL CORPORATION
Paterson New Jersey
A Division of Curtiss-Wright Corporation

WRIGHT Aircraft ENGINES

575 Miles per Hour
IN A FREE DIVE ACHIEVED BY THIS

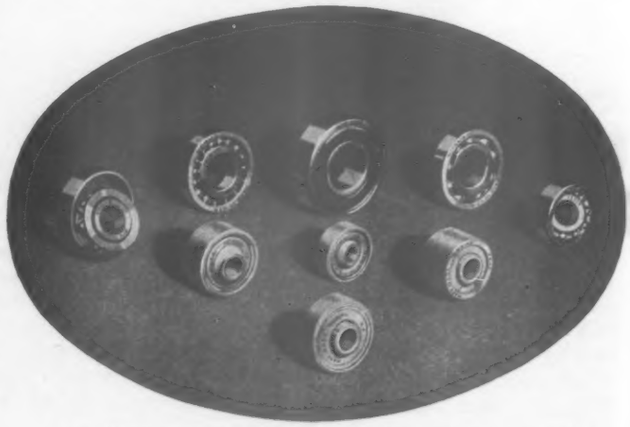
Equipped with

"NORMA-HOFFMANN"
PRECISION BEARINGS

This unprecedented speed was attained under tests by the builders of the above plane—Curtiss Aeroplane Division, Curtiss-Wright Corporation, Buffalo, N. Y. Their successful completion proved the soundness of design and construction, not only of the plane itself but of all the parts entering into it.

NORMA - HOFFMANN PRECISION BEARINGS were employed in both the engine and flight controls of this plane, as well as in the hinges of the actual control surfaces.

Where the bearings must not fail—on land, at sea, or in the air—NORMA - HOFFMANN PRECISION BEARINGS are the choice of engineers and designers of planes, engines (including superchargers), engine accessories, control apparatus, instruments, radio equipment, cameras, and landing field equipment.



The NORMA-HOFFMANN PRECISION line of ball, roller and thrust bearings comprises 108 distinct series embracing over 3000 catalogued sizes—a PRECISION BEARING for every load, speed and duty. Write for the Catalog. Let our engineers work with you.

NORMA-HOFFMANN BEARINGS CORPN., STAMFORD, CONN. U.S.A.

AVIATION MANUFACTURING

Lockheed in High Gear

Production passes one per day as orders pour in

Production at the Lockheed plant during June slipped smoothly into high gear as five of the 14B twin-engine bomber transports rolled out of the factory every four days, and this rate was expected to hit three planes every two days before mid-summer. It is now estimated that Lockheed will be able to complete its huge orders for bombers well within the year. More than 7,000 employees are currently on the payroll, compared with less than 3,000 at the start of the year. As a forward step in employee relations Lockheed has distributed an annual report prepared especially for employees and interpreted in terms of jobs and working conditions. In addition to Lockheed's military business the orders continue to pour in for Model 14 transports and other Lockheed commercial models. Trans-Canada Air Lines ordered six additional Model 14s early in June for delivery during August. When the new planes are delivered Trans-Canada will have 20 Lockheeds in operation, five Electras, and fifteen 14s. Two additional 14s have been ordered by the French Air Ministry for the Mediterranean service to Africa and Madagascar. Three 14s were delivered for this line recently. In enlarging its production facilities Lockheed announces installation of two new resistance electrical welding machines, said to be the largest in size and capacity in any aircraft factory. Built by the Federal Machine & Welding Company, they are capable of welding two sheets of aluminum alloy ⅛th in. thick, and with a throat depth of 50 in. Both seam and spot welding is done.

Douglas Backlog Sets New Record for Industry

Douglas Aircraft Company took another business spurt during May with award of the Army contract for manufacture of approximately $15,000,000 worth of twin-engine attack-bombers. This brought the Douglas unfilled business backlog to a new record level of approximately $50,000,000, and it is believed the Douglas payroll will soon be upped to new levels, probably in excess of 10,000 persons.

In a recent report on first quarter operations, for the three months ended last Feb. 28, Douglas showed net profits of $771,522, compared with $406,771 for the same period last year. Development expenses incurred during the first quarter totalled $616,872, of which $587,907 was charged to current earnings. Much of this development work is thought to represent the secret giant Army bomber project under way, although part of it covers work on the DC-5. At the close of February the balance sheet showed deferred experimental expenses of $1,145,868, including $814,139 for the DC-4 and $321,729 for the DC-5. Completion of the 200th DC-3 transport plane was celebrated by Douglas and American Airlines officials on June 1st, with delivery of the "Oklahoma City" to American Airlines. American Airlines, 100 per cent Douglas equipped, operates 53 Douglas transports.

North American Turns Out Four Each Working Day

A report issued by J. H. Kindelberger, president, reveals that the earnings of North American Aviation, Inc., during the second period of 1939, ending June 30th, will probably exceed the record earnings shown during the first quarter. Earnings for the three months ended March 31st, last, were $1,355,952, and net sales for the three months were $6,078,694. Output is now exceeding all previous production records, with 70 planes delivered in April and 80 shipped in May. Most of these deliveries are against a British order for 400 planes and a French order for 200 planes, of the basic trainer type, with the possibility that the French order will be increased by an additional 200 planes of the same type. As North American is working on a five-day week basis the present production rate approximates four planes per day.

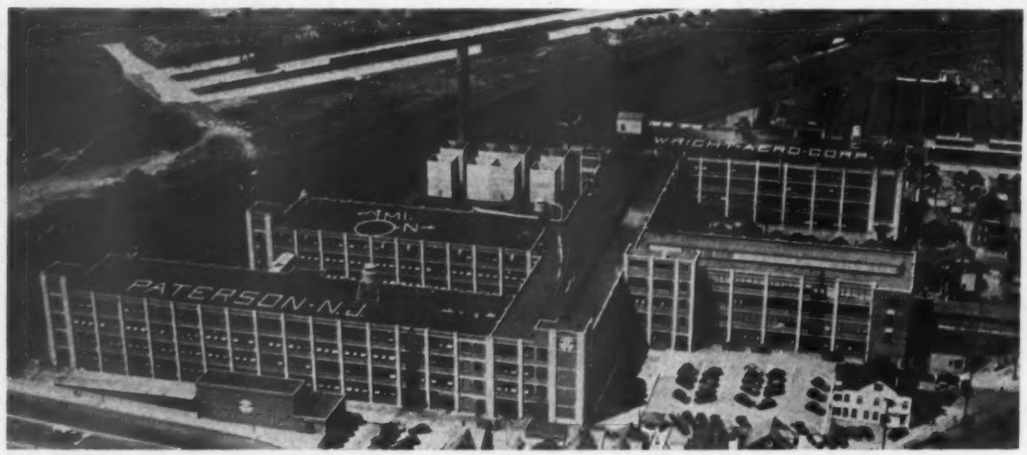
New Firms in California

Subcontracting companies make hay in sunshine

Increasing pressure for military aircraft production is forcing continuation of the expansion of sub-contracting firms in the Southern-California area.

Latest plant to enter the aviation field is the Duplex Cinema Equipment Co., of Hollywood. This firm has been world-famous for many years as developers and manufacturers of some of the moving picture industry's most complex precision equipment such as sound recording devices, color printing machines, and special equipment for trick photography. The firm has also been prominent in the development of television apparatus. The new aviation division will be in charge of Mr. G. W. Carleton, one of the four brothers who operate this unique plant. During the world war he had direct charge of munitions manufacture for the U. S. government, and also perfected an aerial torpedo fuse that was used for depth bombing of submarines. The Duplex Cinema Equipment Company will direct its attention primarily to difficult technical problems in connection with aircraft design and manufacture, rather than straight production work.

On the production side both Interstate Aircraft & Engineering Corp., and Aircraft Precision Products, Inc., have shown rapid expansion of their aircraft parts manufacturing work. A statement by Don Smith, president of Interstate Aircraft & Engineering Corp., reveals that the company has been operating profitably for several months, although the annual statement for the year ended April 30, showed a loss of about $50,000. May business delivered totalled $40,000, and the monthly volume is expected to double this figure shortly. About 130 men were on the payroll on June 1st, with prospects of increasing this to more than 200 within 60 days. This firm contracts primarily for machine work for Douglas, North American, Lockheed, Vultee, and Glenn L. Martin. A statement by Mr. C. A. Herbert, president of Aircraft Precision Products, Inc., reveals that the engineering department has been increased from one to eight men, and that addition of a night shift during June will approximately double the payroll of 80 persons. Backlog of unfilled orders now aggregates $160,000, although this figure does not include experimental work in progress on a cost plus basis. Continental Aeronautic Corp., which recently



ONE MILLION SQUARE FEET: will be the floor area of the Paterson, N. J. plant of the Wright Aeronautical Corp. when a series of five relatively minor additions are finished in September. To cost about $150,000 the new projects add 30,000 sq. ft.; 16,000 sq. ft. of it for assembly.

FIRST FLIGHT PICTURE: The new Consolidated 52-passenger, long-range flying boat shows off its paces above the factory at San Diego. Its two 2,000 hp. Wright Duplex-Cyclone engines give the 25-ton boat remarkable speed.

established a parts manufacturing plant in Burbank, is currently working approximately 150 people on the production largely of sheet metal aircraft parts for various aircraft companies.

Latest of the Southern California accessory plants is the Harvill Aircraft Die Casting Corp., which has offered 100,000 shares of $1 par value capital stock to the public, proceeds to be used for the construction of additional die-casting machinery, payment for the factory, purchase of other equipment, and working capital. Harvill Aircraft Die Casting Corp. manufactures parts for every leading aircraft builder on the Pacific Coast, and for numerous other aircraft firms. Hundreds of thousands of aeronautical items are manufactured, ranging from electrical shieldings to control pedestals, with castings made from aluminum, brass, bronze, lead, magnesium, and zinc alloys. Approximately 3500 Harvill die-cast parts are said to be incorporated in the Douglas DC-4 alone. The company reported net profit of $28,564 for the fiscal year ended April 30th, last, before provision for income and excess profits taxes.

Siebenthaler Additions

Two additions to the staff of the Thomas L. Siebenthaler Company, of Kansas City, have been announced by Ted Lynn, president of Aircraft Accessories Corp., of which the Siebenthaler unit is a wholly owned subsidiary. Robert S. Van Cleve has been named sales manager, and Preston B. Tanner, works manager. Tanner will have active management of production and plant facilities of the Kansas City plant. Van Cleve and his staff are giving particular attention to the perfection of ultra-high frequency transmitting and receiving sets for use on airlines. Van Cleve, formerly with the Bendix Radio Co., has long specialized in radio sales and engineering. Lynn also stated that Aircraft Accessories Corporation will distribute its specialized hydraulic equipment in the East through the Siebenthaler group, as an auxiliary to the principal offices of the corporation in Glendale, Calif.

Soucek to Maxson

Lieut. Commander (U.S.N.R.) Z. Soucek has been appointed vice president in charge of the newly created Controls Department of W. L. Maxson Corporation. Mr. Soucek, a Naval Academy graduate and former Navy flier, joined Eclipse Aviation in 1929, resigning as executive sales engineer, and previously had been superintendent of the Navy's aeronautical engine laboratory at Philadelphia.

Stunkel to Vega

Reagan Stunkel, veteran airline maintenance superintendent, has been named to the executive staff of the Vega Airplane Company, according to announcement of Mac Short, president. Stunkel will be in charge of inspection and service for the company, and will be closely affiliated with the manufacturing and field operation of Vega airplane, the first model of which—a six-place, Unitwin-powered, low-wing monoplane—is nearing completion. Stunkel has been a pilot for 15 years, and has been associated in maintenance work with American Airlines, Delta Air Lines, Bowen Air Lines, and Braniff Airways. He served the latter firm for the past two years as superintendent of maintenance.

Vega Employs 350

Officials of the Vega Airplane Company, Burbank, Calif., have revealed that more than 350 men are now on the payroll as manufacture of the first lot of Unitwin powered light transport planes is rushed. First flights of the prototype plane were scheduled to take place during June. and deliveries are expected to start sometime in July or shortly thereafter. Five planes are being rushed through in the first production lot. Each is powered with two Menasco C6S4 engines driving a single propeller through a common gear box equipped with automatic clutches in event of failure of one engine. The Vega factory, adjoining Lockheed, occupies 77,000 sq. ft. of a six and one-half acre site, and construction is now under way on an assembly hangar approximately 100 by 60 ft. in size.

Brown Heads Fairchild Sales

Fairchild Aircraft Corporation's new sales manager, Archibald M. Brown, Jr., learned to fly in 1928 and for three years was president of the Harvard Flying Club. His previous connections have been traffic operations manager, Island Airlines; reservation clerk and salesman, Eastern Airlines; service manager and assistant sales manager, Edo Aircraft Co.; manager of seaplane base at North Beach Air Service; salesman for Beckwith Havens; and executive secretary of the Seaplane Flying Association.

Torrens Heads Luscombe

J. H. Torrens has been elected president of Luscombe Airplane Corporation, replacing D. Luscombe who resigned in April. The company's new extension at West Trenton, N. J. includes a boiler room and a paint shop. Reporting rapidly increasing sales, the company feels optimistic about the future prospects of its popular-priced, all-metal airplane.

British Note

John H. Millar, president and managing director of Aviation Corporates, Ltd. (formerly Millar Aviation, Ltd.) advises that in addition to representing Consolidated Aircraft Corp., Aviation Equipment & Export, and Brown & Dufreau (Australia), his company is organizing an export business out of England for non-competing British aviation accessories. Their offices are at 25 Beaver St., New York, and 50 Pall Mall, London, and they have sales representatives throughout the British Empire and in leading countries.

Solar Gets Martin Order

Solar Aircraft Company, San Diego, has received an additional $90,000 order from Glenn L. Martin Company of Baltimore, for manifolds and cowl wells, according to announcement of Lon Wheeler, vice-president. Anticipation of this order was said to have been one of the controlling factors in recently doubling the factory capacity. The new Solar factory building was placed in operation June 1st.

Parker Appliance Branch

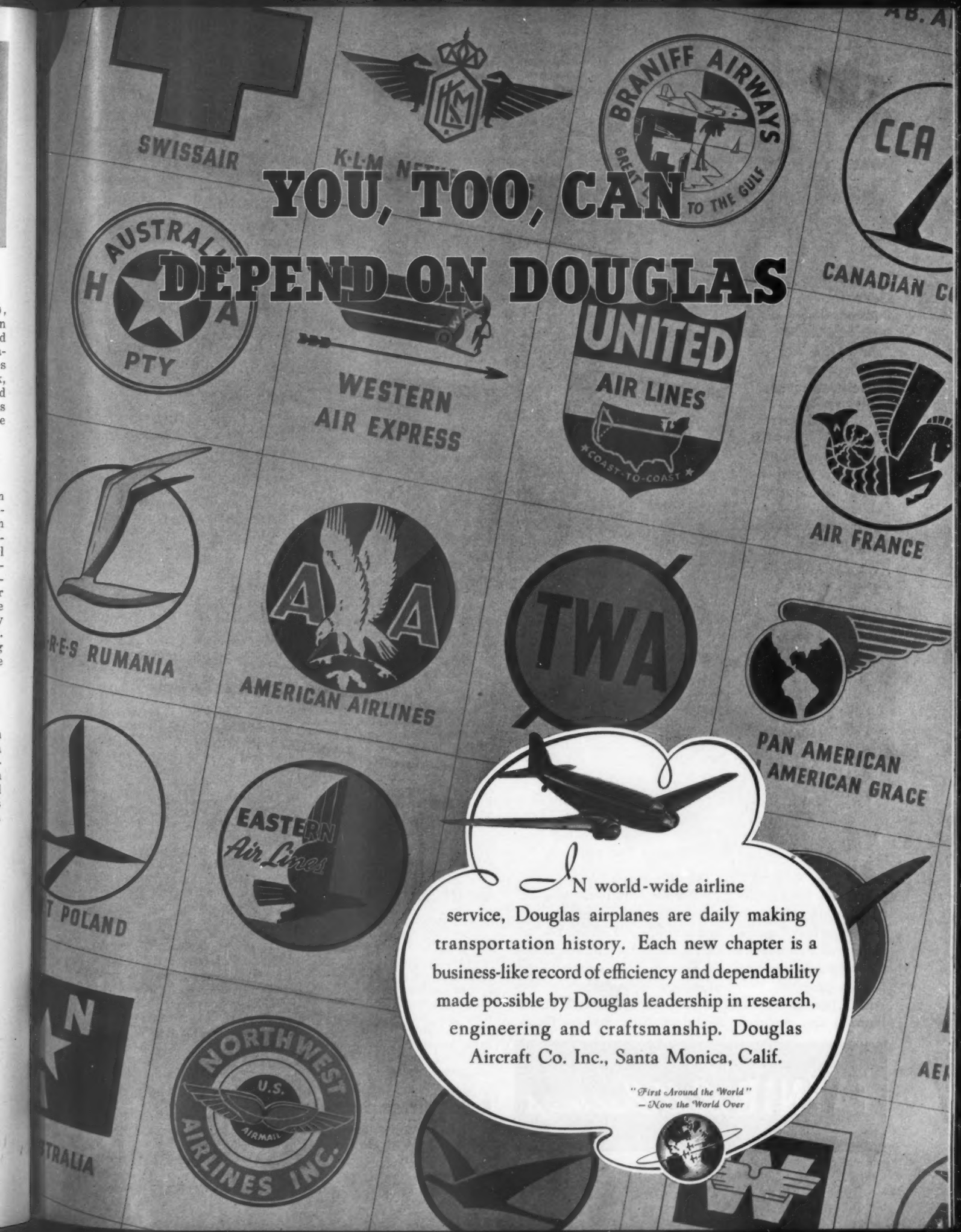
Newest aircraft accessory firm to locate in Southern California is the Parker Appliance Company, Cleveland, Ohio, which has established a service and engineering unit in Los Angeles under the personal supervision of A. L. Parker, pres.

New Firm

Hardman Metal Products Company, has been organized in Los Angeles by Frank Hardman, for manufacture of aircraft units as a sub-contractor to the aircraft industry. He is doing general metal fabrication work for plants in Southern California and elsewhere. Hardman served for a number of years as factory superintendent of the Northrop Aircraft Corp.

Markey Joins Pollak

Roscoe I. Markey formerly Project Engineer with Curtiss Aeroplane Division of Curtiss-Wright, has joined the Pollak Manufacturing Company of Ar-



YOU, TOO, CAN DEPEND ON DOUGLAS

IN world-wide airline service, Douglas airplanes are daily making transportation history. Each new chapter is a business-like record of efficiency and dependability made possible by Douglas leadership in research, engineering and craftsmanship. Douglas Aircraft Co. Inc., Santa Monica, Calif.

"First Around the World" — Now the World Over

THE FAFNIR AIRCRAFT LINE Or Aircraft Engineers

WILL PROVIDE THE

Right Bearing

FOR EVERY SPOT ON EVERY SHIP

Elevator Hinges
Elevator Controls
Rudder Hinges
Rudder Controls
Control Column
Engine Controls
Wheel Retracting Mechanism
Stabilizer Controls
Aileron Hinges
Aileron Controls
Flaps and Controls
Engine Accessory Drives
Engine Rocker Arms
Propeller *(Fafnirs Are Built Into Hamilton Standard Controllable Pitch and Full-Feathering Propellers)*

The Fafnir Aircraft Line is established as the most complete in America . . . but your requirements need not stop there! The fund of engineering and application experience gained in building the Fafnir line has proved of invaluable benefit to many aircraft manufacturers making radical departures from conventional design practice, or who require adaptations of the Fafnir line to specialized requirements. The Fafnir Bearing Co., Aircraft Division, New Britain, Conn.

FAFNIR *Ball Bearings*

lington, N. J., as Development Engineer and Engineering Representative in the aircraft industry. Mr. Markey, who received his technical training at Ohio State University, is a pioneer in aircraft engineering. In

ROSCOE I. MARKEY

joining the accessory field, he brings to it an experience gained in twenty years of airplane engineering. In this time, he has been instrumental in the design and development of some 30 models of airplanes covering all types and sizes.

He will be in direct charge of Pollak's experimental Engineering Department. The Pollak Manufacturing Company organized in 1923 is one of the oldest builders of aircraft cowlings, exhaust manifolds and fuel tanks in the country. At present, it employs more than 400 workers.

Ryan Order for XPT-16's

Although announced in Washington as a contract for "observation planes," the contract for $50,000 worth of Ryan aircraft is for the XPT-16, newest military version of the popular Ryan S-T series of sport and military training planes. It will be used by the Air-Corps for the primary training of cadet pilots.

Enyart to Aerocessories

William R. Enyart, secretary of the National Aeronautical Association, has been named General Manager and Treasurer of Simmonds Aerocessories, Inc.

Simmonds Aerocessories maintains offices at 551 Fifth Avenue, New York City, and a factory in Long Island City, and are designers and manufacturers of specialized aeronautical accessories.

Kellett Heads Seversky

Wallace W. Kellett, former vice president of Seversky Aircraft Corporation, has been made president, to succeed Major Alexander P. de Seversky, who remains a director. Other directors are Mr. Kellett, J. S. Powell, J. J. Daly, Paul Moore, Livingston Platt, and H. N. Taylor. The company has been awarded a War Department contract for planes and parts costing $974,324.

Fitzpatrick to Carstenite

James R. Fitzpatrick, well known in the aeronautical industry for his plywood sales work, is now associated with Mr. A. N. Carstens in a corporation known as Carstenite Sales of 228 North La Salle St., Chicago. The firm has just been given the exclusive sales rights of aircraft plywood produced by American Plywood Corp.

Stinson Booms

The Stinson Aircraft Division of Aviation Manufacturing Corp., with orders on hand of more than three hundred thousand dollars for their new Stinson 105, have begun production on 500 ships of that type. As though just to prove once more that it never rains but it pours, Stinson last month received a contract calling for $1,500,000 worth of two-place, single engine monoplane observation planes from the U. S. Army Air Corps. Of short range, they will be especially designed to serve an infantry division and direct artillery fire.

ATC for Rearwin

The Rearwin Cloudster, side-by-side, high wing cabin monoplane, developed by Rearwin Aircraft and Engines, Inc. of Kansas City, Kansas, has been granted an ATC with the Ken-Royce 90 hp. engine. The ship is reported to have shown unusual good flying characteristics throughout its tests. Priced at $3,495, it has brakes, tail-wheel, position lights, custom-styled cabin and carburetor heater as standard equipment. Approval has also been announced for the model 7F Ken-Royce engine. It developes 120 hp. at 2,225 r.p.m.

James A. Wales, Jr., formerly of the Wales Advertising Co. in New York has joined the Rearwin's in the sales and advertising department.

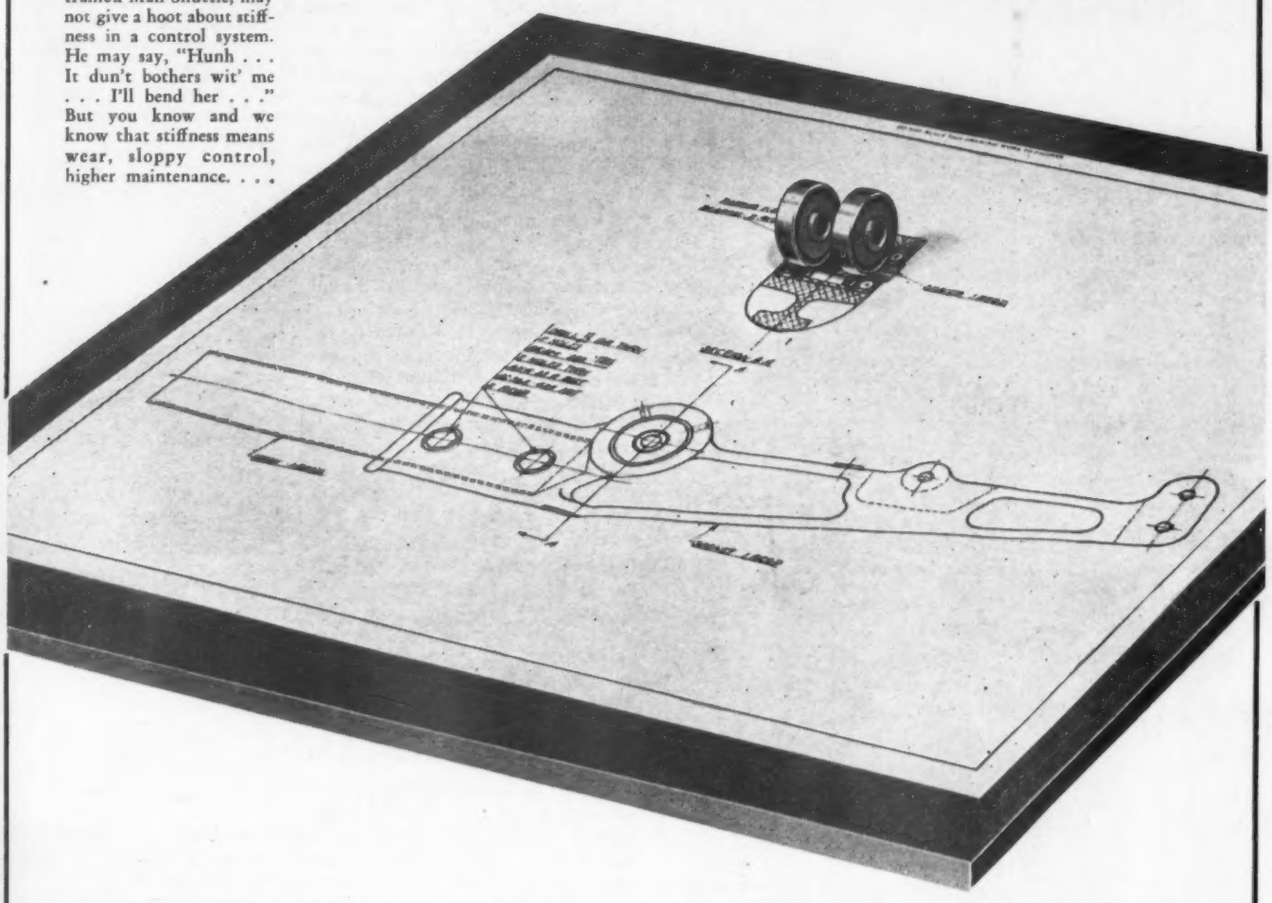
Correction

The Aviation News erred last month when it stated that export sales for Howard Aircraft would be handled by a division of the Aviation Manufacturing Corp. Howard exports will be handled by a special unit of the Howard organization itself.

A LITTLE ENGINEER BEATS A HEFTY PILOT . . . . . .

The drawing board's the place to cure "CALCIFIED CONTROL COLUMNS!"

Stanislaus Matczheck, chief pilot of the Hamtramck Mail Shuttle, may not give a hoot about stiffness in a control system. He may say, "Hunh . . . It dun't bothers wit' me . . . I'll bend her . . ." But you know and we know that stiffness means wear, sloppy control, higher maintenance. . . .



Grazing cows are vanishing from airports . . . chocks are giving way to brakes . . . and mind is triumphing over muscle in aircraft operation . . . and design! See, on the blueprint above, how one of the country's leading aircraft builders forever outlaws stiffness from his control column . . . by lettering "Fafnir K5" *right on the blueprint!*

That unimportant-looking inch of lettering takes but a moment to put on, but its significance will be felt throughout the weeks of the ship's construction . . . and the years of its useful life. For the manufacturer's engineers will find Fafnir's specialized Aircraft Division ready with the answers to any problems of bearing application. The purchasing department will be pleased with prompt service and cooperation from Fafnir's "friendly factory." Assembly will like the way the Fafnirs fit into place; meeting specifications to the letter.

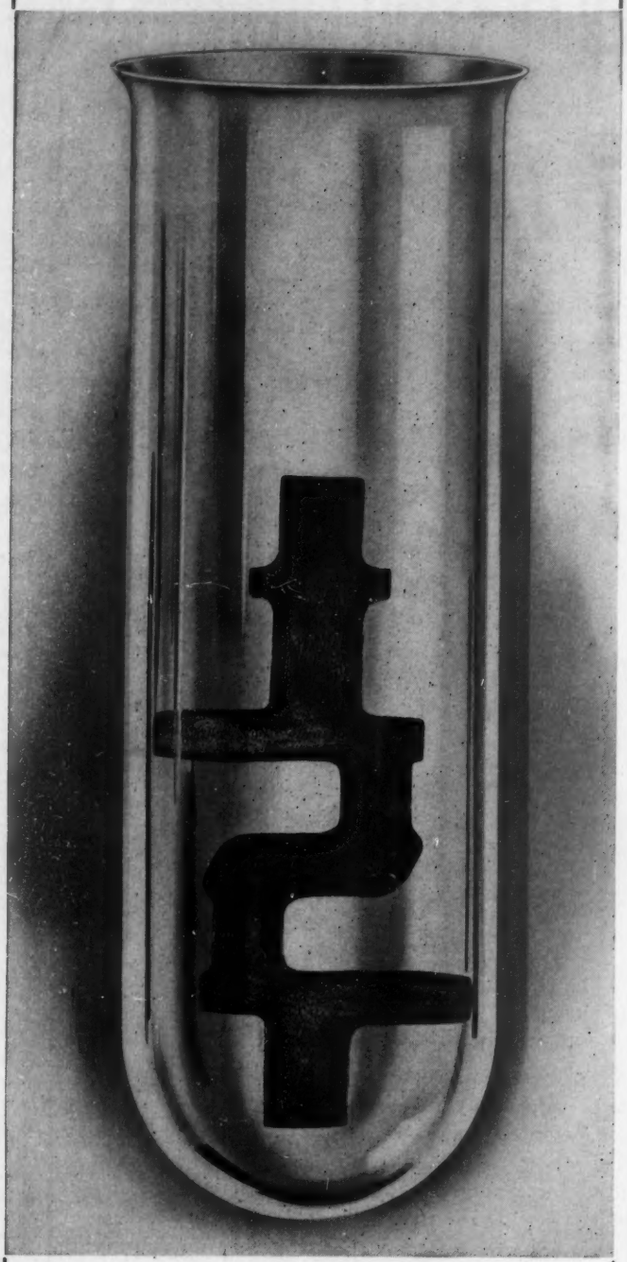
And the man who buys this ship will be eternally grateful for a control column that's friction-free and trouble-free, through thousands of flying hours of heat and cold and constant movement. The Fafnir Bearing Company, New Britain, Conn.

"THE AIRCRAFT BEARING SPECIALISTS"

FAFNIR *Ball Bearings*

THE BALANCED LINE • MOST COMPLETE IN AMERICA

Laboratory Controlled



Note the Grainflow

WYMAN-GORDON

WORCESTER, MASS.

HARVEY, ILL. DETROIT, MICH.

Guaranteed Forgings

ENGINEERING

Engineering Events

Summer to offer many good meetings

Coming months offer a particularly attractive schedule of meetings of interest to the aeronautical engineer.

On June 30 and July 1 the institute of the aeronautical sciences will hold a meeting at Elmira, New York, in connection with the Tenth Annual National Soaring Contest. July 10 the American Society of Mechanical Engineers will hold a session on trans-oceanic flying at the San Francisco World's Fair.

From Sept. 4 to Sept. 8 the Mechanical Engineers will hold a joint meeting in New York with England's Institute of Mechanical Engineers to discuss the mechanical problems of modern transportation. From Sept. 11 through Sept. 15 the Institute of the Aeronautical Sciences will hold an International Congress at Columbia University with a dinner on the 15th to climax the meeting.

Headliner for October will be the Society of Automotive Engineering's National Aircraft Production meeting at Los Angeles.

Arthur Nutt Surveys Engine Progress for S.A.E.

One of the outstanding papers presented at the World Automotive Engineering Congress of the S.A.E. held at San Francisco, June 7, was that on "Aircraft Engines and their Lubrication," by Arthur Nutt, vice-president of engineering for the Wright Aeronautical Corporation. As the engineer directly responsible for the development of the new 2,000 hp. eighteen-cylinder Wright Duplex-Cyclone he was well qualified to speak on that subject.

Between 1925 and 1939 the specific weight of the Cyclone engine decreased from 2.2 lb. per hp. to approximately 1.1 lb. In his paper, Mr. Nutt discusses each of the separate factors which contributed to the improvement. The paper complete covers some 28 double-spaced typewritten pages. Here are some of its highlights:

On Co-Axial Propellers:..."With the increase in engine power and speed the propeller problem becomes more complicated . . . Co-axial propellers, namely, two propellers rotating in opposite directions on one propeller shaft appears to be one answer to this problem. Not only is a small diameter propeller obtained but engine torque is eliminated, making a very nice handling airplane as far as ground and flying characteristics are concerned. There may be a slight penalty in propeller efficiency but to date there is no evidence to show that such is the case. There will be a slight penalty in weight probably but the gains will more than compensate for this fact. The interest in the construction of co-axial propellers has probably been lukewarm because of the complication of the design of controllable pitch propellers which is not insurmountable."

ARTHUR NUTT

Accounts for 1.1 lb. per hp.

On cooling: . . . "The improvement in cooling . . . shows an increase in cooling area in the cylinder head of about 600 sq.in. to approximately 2,300 sq.in. . . . The limit on cooling has not been reached by any means . . . Considerable research work is now taking place on various methods of applying fins to cylinders which will provide thinner, deeper and closer spaced fins . . . The writer believes if sufficient finning is applied to an air-cooled cylinder head that decreased sensitivity to detonation, decreased fuel consumption, less sensitivity to cooling air temperature variation and higher brake mean effective pressure will be obtained."

On the Dynamic Damper:. "One of the items which has contributed more toward the development of aircraft engines during the past twenty years than any other single item is the dynamic damper . . . The introduction of this damper . . . has made it possible to increase

the power of present aircraft engines without increasing the weights of the crankshaft and propeller systems . . . Almost any undesirable order of vibration can be eliminated by the construction of dampers tuned to the proper frequency. The damper has taken the crankshaft and propeller system definitely out of the 'cut and try' empirical design class."

On Lubrication: . . . "In regard to the lubrication of aircraft engines, there is little question that the progress in the development of lubricating oils has not kept pace with the progress of fuels and engine development.

The results of the oxidation of oil are very evident when an aircraft engine is torn down for examination after 500 hours of airline operation . . . Manifestly a great deal of research work should be done to eliminate this tendency for lubricating oil to oxidize . . . Oil consumption is considered to be an important factor, particularly on long range airplanes, and it takes little mathematics to figure the saving possible by a reduction in oil consumption of .01 lb. per brake horsepower during a twenty-hour flight.

On Dynamic Suspension:. . ."Professor E. S. Taylor and K. A. Browne developed what is known as 'Dynamic Suspension,' . . . Briefly, the system is similar to the Chrysler 'floating power' but is accomplished by means of the suspension all on the rear of the engine . . . As an example of what this device will do to an engine installation, a 40 per cent reduction in vibration was measured by a vibration apparatus in one two-engined airplane. The use of this system and the principle involved will naturally permit the use of even higher power engines without the detrimental effects of vibration or explosion forces on the airplane structure and passengers . . ."

On Fuel Injection: . . . "Spark ignition engines are being produced there in Germany in production using gasoline injection into the manifolds. It is believed that if the so-called safety type of fuel is to be used in spark ignition engines that it will be necessary to inject the fuel into the cylinder to obtain the benefit of the heat compression required to obtain satisfactory vaporization. The writer believes that more engines will be built with fuel injection in the future using the so-called safety type of fuel of high octane number. The development of fuel injection has been retarded primarily because of the introduction of the ice-free carburetor and also the lack of satisfactory high octane, low volatile fuels at a reasonable price. With new fuels recently in the picture and the desire for elimination of highly volatile fuels from the standpoint of fire hazard, there are sound reasons for going ahead with the further development of fuel injection."

MAN WITH FLAP: P. P. Nazir, for the past four years a research worker in aerodynamics at Queen Mary College, London is presently in America. He holds patents on an interesting-looking "cut-flap" designed to decrease stalling on tapered wings, without loss of lift.

FINANCE

» Aero Supply Manufacturing Co., for quarter ending March 31, 1939, net profit of $16,768, equal after dividend requirements on Class A stock, to 2 cents each on 425,121 Class B shares.

» Air Associates, Inc., declared the regular quarterly dividend of $1.75 per share on the first preferred stock, payable July 1, 1939; and the regular quarterly dividend of 12½ cents per share on the common, payable June 26, 1939.

» AMERICAN AIRLINES, INC. and subsidiaries, for quarter ending March 31, 1939, net income of $23,801 after depreciation, interest and Federal income taxes, equal to 8 cents each on 292,044 capital shares. Compares with net loss of $232,008 for same period last year. Expenses for the period were $2,270,691 against $1,980,950 in like 1938 period. Income before deductions for depreciation, obsolescence, interest, taxes, was $338,508 against $195,721, a gain of 73 per cent.

» THE AVIATION CORPORATION offered to stockholders of record on June 22, 1939, additional shares of capital stock of the company in the ratio of one new share for each three shares held, at a price to be determined later. Rights to subscribe were mailed on July 6, 1939. In order to assure the receipt of the additional capital, the company plans to contract with a group of underwriters, headed by Schroeder, Rockefeller & Co. and Emanuel & Co. to purchase all shares not subscribed for by the stockholders.

» BARKLEY-GROW AIRCRAFT CORP. filed statement with the SEC covering 170,000 shares of $1 par value common stock. The shares were offered for subscription pro rata to stockholders of record June 20, at $2.50 each in the ratio of four for one. Rights, expiring July 10, are not transferrable, and are exercisable only in amounts calling for full shares. The shares not subscribed for by stockholders may be offered or sold at any time after July 10 at prices determined by the Board of Directors, but not less than the book value of such shares at the end of the calendar year preceding the date of such sale.

» BORG-WARNER CORP. (of which Pump Engineering Service Corp. is a recently acquired subsidiary), declared a dividend of 25 cents a share on the common stock, payable July 1 to stock of record June 16, 1939.

» CESSNA AIRCRAFT CO. for four months ending March 31, 1939, net loss of $1,123.

» CONTINENTAL MOTORS CORP., for quarter ending April 30, 1939, net profit of $15,430, against net loss of $141,664 in preceding quarter, and net loss of $29,693 in the same 1938 quarter. For six months ending April 30, 1939, net loss of $126,234, compared with loss of $190,421 for like 1938 period. Unfilled orders, about $2,800,000.

» Curtiss-Wright Corporation authorized a dividend of 50 cents a share on the Class A stock. Last year the company paid one dividend of $1 on Dec. 15.

» EASTERN AIR LINES, INC., for quarter ending March 31, 1939, net profit of $233,125, after $177,346 for depreciation, amortization, and obsolescence; $70,000 for Federal income tax; $30,000 for reserve. Equals about 56 cents a share on 417,666 shares of $5 par capital stock, and compares with income of $98,822 or 24 cents a share in the 1938 quarter. Earnings for the last quarter of 1938 were $216,661 or 52 cents a share after deductions of $169,857 and net favorable year-end adjustments of $65,065.

» GRUMMAN AIRCRAFT ENGINEERING CO., dividend of 25 cents, payable June 7 to stock of record May 21. Previous dividend of 25 cents in December, 1938.

» Howard Aircraft Corp., for four months ending April 30, 1939, net loss of $87,646.

» Transcontinental & Western Air, for quarter ending March 31, 1939, net loss of $364,844, a decrease of $113,262 in the losses reported for the same period last year. Operating revenues were up $68,406 over last year's period, being $1,321,874 for 1939. Operating expenses decreased $48,661 from the 1938 quarter.

» UNITED AIRCRAFT PRODUCTS, INC. of Dayton, O., through Burr & Co. and John J. Bergen & Co., made public offering of 93,585 shares of common stock at $6.25 a share. Net proceeds from the sale of 10,000 shares purchased from the company will be added to the corporation's working capital for expansion, the remaining 83,585 shares to be acquired from individual owners who will receive the net proceeds from their sale. The company was established in 1929 and manufactures aircraft accessories and equipment for sale to aircraft manufacturers. Net sales have increased in each of the last six years from $121,672 in 1933 to $565,414 in 1938. The company has no funded debt other than a first mortgage on land and buildings which has been reduced to $24,834.

» United Air Lines Transport Corp., for the quarter ending March 31, 1939, net loss of $419,085, after taxes and other charges, compared with loss of $667,670 in the 1938 period. Operating revenues for the quarter exceeded last year's by 17.1 per cent. During the period, the 20,443,726 revenue-passenger miles flown represented an increase of 26.5 per cent over last year. Increases in express pound-miles and mail pound-miles were 11.6 per cent and 7.4 per cent respectively.

AVIATION PEOPLE

TWA Takes Over The Page

VICE PRESIDENT: Vincent P. Conroy, General Traffic Manager, has been elected vice-president of TWA in charge of traffic sales. A former Naval Officer, Conroy has been in airline traffic for 12 years, working for National Air Transport, United and Eastern before joining TWA a year ago. In his Naval Academy days, he was a first-rate football player.

CHIEF OF FIELD SERVICE: Walter A. Hamilton, engaged in Maintenance Engineering since 1925, when he, Jack Frye and Paul Richter were officers of the Aero Corporation of California, has resigned as Superintendent of Maintenance for TWA to become the Chief of Field Service for Douglas Aircraft. In 1937 he won Aviation's Maintenance Award.

SUPERINTENDENT: William Maxfield, Assistant Maintenance Superintendent of TWA since 1930, steps into the post of Superintendent of Maintenance. Twenty years ago Maxfield was Maintenance Foreman at Salt Lake City in the first transcontinental airmail service. After a long Army career, he joined Western Air Express, transferring later to TWA.

CHIEF ENGINEER: D. W. Tomlinson for many years widely known through the industry for his test flying and high altitude research work, for TWA, has been appointed Chief Engineer of that air line. Commander of the Crack Naval Reserve Squadron Ps-12 at Kansas City, Tomlinson will be in charge there of TWA's new Engineering Department.

MISS AMERICAN AVIATION: Miss Katherine Wilson, R.N. was selected in May to go as Miss TWA to the National Air Carnival at Birmingham, Alabama. June 3, as a climax to the Carnival's Aviation Ball, judges found Miss Wilson worthy of selection as Miss American Aviation. Specifications—Height, 5 ft. 3 in.; hair, blonde; eyes, blue; gross weight 112 lbs.; age, 23. She has been a hostess on the Phoenix-San Francisco run for TWA since August 1938.

SCHOLAR: Robert Zimmerman, a graduate of Purdue University, joined TWA in 1932 as a mechanics helper. Two years later he was made project engineer in charge of airway and airport construction. Now, as winner of an Alfred P. Sloan Foundation scholarship, at the Mass. Institute of Technology, he will take a year's leave of absence to study business administration at that school. He is the first person connected with aviation to win the much-sought-after Sloan award.

SUPERINTENDENT: J. A. Collings, Superintendent of the Eastern Operations Division of TWA has been appointed System Superintendent of Operations with headquarters at Kansas City. A veteran Army pilot, Collings joined T.A.T. in 1928, stayed on with TWA. He succeeds S. D. Welsh who has been transferred as Flight Superintendent to Los Angeles. J. S. Bartles, Flight Superintendent at Chicago, will succeed Collings as superintendent of the Eastern Division.

Warner Power Range

NOW

90 H.P. to 165 H.P.

The Warner Super Scarab, 165 H.P. at 2100 R.P.M., with pressure lubrication to all valve mechanism, takes its place, along with three other distinguished Scarabs of lower horse power, to bring Warner performance, reliability and economy to a broader range of modern aircraft. The new Super Scarab provides 175 H.P. for take-off when equipped with two position or constant speed propeller.

Scarab

ENGINES

P., 125 H.P., 145 H.P., 165 H.P.

WARNER AIRCRAFT
CORPORATION
DETROIT . . . MICHIGAN

TRANSPORT AVIATION

P.A.A. Moves Ahead in the Atlantic

Will open "Northern" route June 24; "Southern" route passenger service, June 28

With three big Boeing-314 flying boats already shuttling back and forth between the United States and Europe on a weekly mail service via the "southern route," Pan American Airways announced on June 12 a series of immediate forward steps in that service. A fourth clipper was due on the East Coast during that week. Mail service would be inaugurated across the "northern route," via Newfoundland and Ireland to Southampton, on June 24. Passenger service across the "southern route" would be inaugurated on June 28.

The fare to Marseilles from New York was announced at $375 one way or $675 for the round trip including all meals and services aboard the plane and an allowance of 55 lb. of baggage for each passenger. For the first few flights, at least, there will be an overnight stop at Lisbon, Portugal, before the clippers reach the end of their eastern journey. Meanwhile, Pan American is negotiating with the Spanish Government for permission to fly across that country which would make such an overnight stop unnecessary. As presently set up, the eastward trip to Marseilles requires a total of about 44 hours, the westward return flight takes about 52 hours. The company already has filed plans with the Civil Aeronautics Authority for an eventual schedule of four flights to Europe each week, two over the southern route to Marseilles, two over the northern route to England.

American Gets Its 53rd Douglas

American Airlines has taken delivery of five new Douglas DC-3 transports to bring its total of Douglas planes in service up to 53. Casting up its records, American finds it has flown more than 35,000,000 miles to date in Douglas equipment, logging more than 425,000,000 passenger-miles. Total number of passengers carried in American Douglas comes to some 1,005,000 or more than the total population of Cleveland. Of this total 84,512 have flown in Flagship Skysleepers on trans-continental flights, accounting for approximately 90,000,000 passenger-miles.

More Safety

Index rises 500 per cent in year

The CAA has finally issued full statistics on the safety record for the last half of 1938. It seems well worth waiting for. From July 1 through December the Domestic operators flew 36,526,538 miles and logged 306,580,689 passenger-miles with only four passenger fatalities. That gives a passenger miles flown per passanger fatality index of 76,645,172. Compare this with an index of 15,115,942 passenger miles per passenger fatality for the second half of 1937 and you have almost exactly a 5 fold increase in airline safety. What makes it even more encouraging is the fact, reported in May issue of Aviation, that for the spring of 1939 (precisely from December 21 through March 20) the index stayed up at 64,081,025 passenger miles for each passenger fatality.

It all makes quite a feather for the CAA to sport on its cap. With CAA encouragement, you will remember, the lines got together last summer in Chicago and agreed to foreswear any sort of competitive dispatching or schedule rivalry which might lead toward incautious flying. From the results it would seem that everyone concerned lived up to the spirit and the letter of that agreement 100 per cent. Other contributing factors were the comparatively excellent condition of governmental ranges and beacons upon which some 5 million dollars has been spent during the last two seasons; general advances in weather forecasting accuracy, maintenance effectiveness, etc.

C.A.A. Opens Research Center

Will work out range, beacon and beam problems at Indianapolis

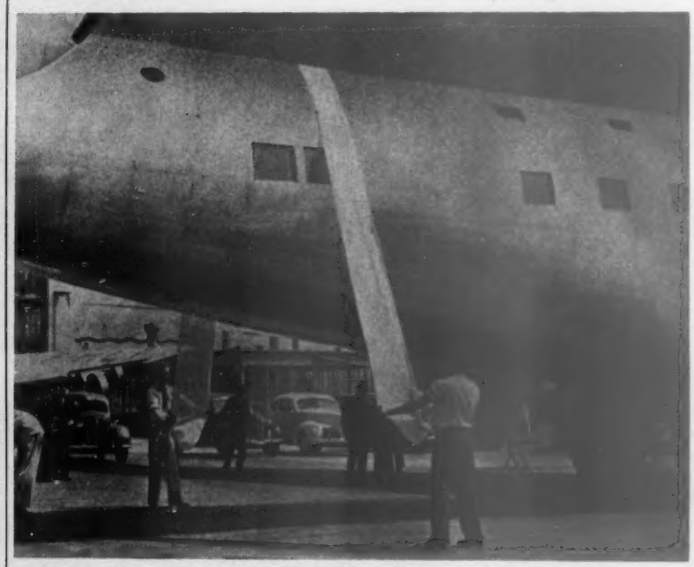
With a proper touch of ceremony, the city of Indianapolis turned over to the Civil Aeronautics Authority on May 29 that part of its municipal airport which the CAA will henceforth use as its main experimental station. Mayor Reginal Sullivan represented the city. Chairman Robert Hinckley represented the authority and made the speech of acceptance.

Located just west of the municipal airport proper, the CAA's new station is part of a 1,000-acre tract which the city originally set aside for airport purposes. The field has two 4,000 ft. runways providing for landing in four directions. The combined hangar and shop space which will be occupied by the CAA covers an area of 150×120 ft. with a second story 30×120 ft. above the office portion.

At present the experimental equipment consists of an ultra-high frequency (63 megacycle) radio range which has been operating for some time in a comparative service test with a standard range of about 300 kilocycles. There is also in operation a complete instrument landing system and a test set-up for various types of airport lights.

The blind landing set-up can be readily adapted to test out any of the various radio landing systems now available by changing plane receiver units and the glide path transmitter on the ground. The most immediate objective, however, is understood to be a thorough field testing of the new Metcalf-M.I.T. type of beam. Three airlines which operate through Indianapolis are already cooperating, but most of the testing will be conducted in CAA planes. So far one Waco with a tricycle landing gear has been placed in service for the ultra-high beam test and a Stinson has been in use for the instrument work.

The new center will for the first time give the branch of the government in charge of maintaining the nation's airways a headquarters for vital experimental work. Up till now such experiments have been widely scattered over the country with the result that coordination has been extremely difficult.



SHINE 'EM UP? Malden trans-continental flights are not to be taken lightly. Here two young men polish up the DC-4 with a bolt of cheese-cloth before its first trip East.

Safety Board Reports On Stratoliner Crash

Makes elaborate suggestions on future procedure

June 1, 1939, the Air Safety Board transmitted a report to the C.A.A. covering its investigation of the Boeing Stratoliner crash near Alder, Wash., on March 18. The report is interesting for its findings that the ship had gone into an inadvertent spin, that the pull-out from the resulting dive had been made too abruptly and that thereafter the wings and hori-

zontal tail surfaces had failed structurally due to the imposition of loads in excess of those for which they were designed. The report is significant far beyond those findings in that it is remarkably more detailed than the general run of accident reports rendered in the past and because it contains a number of recommendations designed to increase the rigor of C.A.A. regulation of test flights.

Some of the recommendations were that: The C.A.A. should undertake studies for the prevention of flutter in control surface tabs on all aircraft and investigate the factors which cause or contribute to flutter of aircraft structures, and that minimum requirements based thereon be included in the C.A.R. . . . That the C.A.A. should require all future civil aircraft to be so designed as to eliminate critical stall characteristics and be inherently spin-proof. . . . That the C.A.A. expedite the development of an adequate stall warning device and require its installation on all carrier aircraft. . . . That the C.A.A. require extensive wind tunnel tests on all aircraft designed for air carrier service. . . . That it investigate the tendency in certain large aircraft designs to so reduce the forces required to operate the controls as to permit undue stresses being imposed inadvertently on the aircraft. . . .

Meanwhile Eddie Allen, now Director of Aerodynamics and Flight Research for Boeing, began putting Stratoliner No. 2 through an exhaustive series of tests. Shortly after the Safety Board issued its findings, the Boeing Company issued a statement in part as follows:

"The Stratoliner was, at the time of the accident, and still is, in the middle of a highly comprehensive test program, involving maneuvers of all sorts and operations under all varieties of conditions. . . .

"Out of every accident, lessons are learned, and the Civil Aeronautics Authority doubtless intends to apply any lessons learned from the Stratoliner accident not only to this airplane but to all airplanes. . . .

"In accordance with the company's established practice, any modifications in the Stratoliner that we may find desirable as a result of the tests already conducted, or the further exhaustive tests yet to be conducted, will be incorporated in the airplane as the test program proceeds. We believe that the Stratoliner offers tremendous possibilities in filling the needs of modern air transportation, and we are carrying our tests to great length to assure that this airplane will be as superior from the safety standpoint as it promises to be from the standpoints of comfort and operating efficiency. . . .

"Meanwhile flight testing of the Stratoliner's cabin supercharging, or "altitude conditioning" equipment will be started. This equipment, which has not been tested in flight previously, is the Stratoliner's salient feature, designed to provide the comforts of normal atmosphere within the airplane when it is flying either at or above present operating altitudes. . . .

"After the manufacturer's tests are completed the plane will be released to the Civil Aeronautics Authority for the further exacting tests required by the government. . . ."

TRAFFIC

» AMERICAN AIRLINES carried 47,722 revenue passengers during May for a total of 17,900,737 passenger miles. This latter figure represents a gain of 43.1 per cent over May 1938.

» BRANIFF AIRWAYS reports a revenue passenger mileage for May of 1,633,615. An improvement of 40.2 per cent over May 1938.

» TWA reported a total of 5,986,564 passenger miles during the first twenty days of May, an all time record for the air line. This represents a gain of 36.45 per cent over May, 1938.

» UNITED AIR LINES logged 12,648,400 revenue passenger miles in May, an increase of 28 per cent over May 1938.

AIR TRANSPORT INDICATOR

June 1, 1939

136.1

Which is the ratio of the passenger-miles reported by the Air Transport Association for all domestic lines for May, 1939, to the figure for May, 1938.

Trends for the year continued excellent. For the first five months, traffic stood at 214,976,000 passenger-miles — up 33.7 per cent.

THE CONTROL TOWER

by DAN SAYRE

Thoughts Aboard the DC-4 Enroute New York

The biggest thing about this airplane is not its wing span or its overall length or its gross weight. Its the difference between the ride it gives a passenger from the ride a passenger gets in any earlier land plane.

Part of it is roominess. The individual chairs are the largest we've ever test-sat and, incidentally, the most comfortable. They are arranged two on each side of the aisle, but there is lots of room for legs and for climbing out past the inside passenger. The aisle is wide enough for shuffleboard. Possibly because so great a part of the fuselage is devoted to the main passenger compartment and everything is on one level, you get even more feeling of space and room than in the sub-divided Yankee Clipper.

But there are other factors. The cabin is two or three decibels quieter than a DC-3, which represents a big drop in noise level. The ship is very steady in bumpy air. The windows are big enough to make the cabin light and airy. The overall result is a lack of travel fatigue such as we have never previously experienced on any form of transport.

It's a good pilot's airplane, too. As you've heard, a seat is provided for a third member of the flight crew. In this first model it takes the form of a big chair mounted on a gate-hinge arrangement so that the third member can take a position between and just slightly to the rear of the pilot and co-pilot. Or he can move back to the side of the control cabin several feet behind the pilot. Talking to Benny Howard, you gather that even United Air Lines has not yet made up its mind just what the third man is to do. Evidently, domestic pilots after so many years of having everything at their finger tips are not yet ready to relinquish complete control of engines, radio, or navigation to a separate crew member along the Pan American pattern. Probable upshot is that the third man will be substantially a second co-pilot and will help with the work in all three of those departments. Benny Howard thinks a third man could be kept busy doing nothing but the paper work now required of a transport crew in filling out flight reports, memoranda to the maintenance department, flight logs for the passengers and so on.

There's a lot of wallop packed away in those four Pratt & Whitney SA4-G 1,450 hp. Twin Hornets. When the pilot opens up for take-off—what with the plane being practically in flight position anyhow—the DC-4 has a pick-up like an Austin, powered with a Rolls-Royce engine. The run on both landing and take-off is substantially the same as that required by the DC-3. General stability is good, the controlability is reported excellent for so large an aircraft. Evidently, the technique of the three-wheel landing is not difficult to acquire. United pilots, some of them brand new to the ship, set it down gently and smoothly.

Just to prove the sincerity of our enthusiasm, we offer just one criticism. It's the same complaint we registered two months ago about the Yankee Clipper. The scheme of decorations seems to us just too darned restrained. Perhaps on a year-in-year out basis, the calm tans and grays which dominate the color scheme will pay dividends in restfulness. They may even be important elements in that lack of fatigue we mentioned earlier. But no one is ever going to use the phrase "As modern in decoration as the inside of the DC-4." To us that seems a pity.

AVIATION OPERATORS CORNER

There's money in photography. If you don't believe it look at the list of contracts recently awarded by the A.A.A. to a large numbers of operators. Purpose of this work is to determine the area of fields on the farms under the conservation phase of the A.A.A. program. The contracts, totalling $622,647 for 283,716 square miles, were awarded recently as follows:

Illinois—13,160 square miles; Iowa Aerial Surveys, $31,584.00. Indiana—7,017 square miles; Kargl Aerial Surveys, $17,472.33. Iowa—15,416 square miles; Aero Service Corporation, $33,015.20. Michigan—13,204 square miles; Abrams Aerial Survey Corp., $32,349.80. Minnesota — 26,982 square miles; Abrams Aerial Survey Corp., $69,613.56. Missouri—17,041 square miles; Park Aerial Surveys, Inc., $33,229.95. Nebraska—32,291 square miles; Kargl Aerial Surveys, $80,071.47. Ohio—8,649 square miles; Holmberg Air Mapping Company, $17,816.94. South Dakota—21,-162 square miles; Park Aerial Surveys, Inc., $44,440.20. California — 8,042 square miles; Fairchild Aerial Surveys, Inc., $16,486.10. Kansas — 25,686 square miles; Aero Service Corporation, $43,666.20. Montana — 2,735 square miles; Kargl Aerial Surveys, $9,216.95. North Dakota—10,677 square miles; C. S. Robinson Aerial Surveys, $23-916.48. Oregon — 4,458 square miles; C. S. Robinson Aerial Surveys, $10,342.56. Washington—6,715 square miles; Pacific Aerial Surveys, Inc., $15,645.96. Wyoming—1,957 square miles; Kargl Aerial Surveys, $6,595.09. Alabama — 3,687 square miles; Fairchild Aerial Surveys, Inc., $7,779.57. Arkansas — 3,877 square miles; Papin Aerial Surveys, $8,141.70. Arkansas—8,494 square miles; C. S. Robinson Aerial Surveys, $17,242.82. Florida—2,246 square miles; Aero Service Corporation, $5,-120.88. Georgia—1,414 square miles; Aero Service Corporation, $3,223.92. Georgia—1,971 square miles; Fairchild Aerial Surveys, Inc., $4,158.81. Louisiana—4,326 square miles; Edgar Tobin Aerial Surveys, $9,-300.90. Louisiana—4,535 square miles; Papin Aerial Surveys, $9,523.50. Louisiana — 1,094 square miles; Edgar Tobin Aerial Surveys, $2,330.22. Mississippi — 1,414 square miles; Edgar Tobin Aerial Surveys, $3,040.10. Oklahoma — 6,012 square miles; C. S. Robinson Aerial Surveys, $12,504.96. South Carolina — 2,527 square miles; Aero Service Corporation, $5,761.56. Texas — 1,556 square miles; C. S. Robinson Aerial Surveys, $3,236.48. Texas —17,749 square miles; Edgar Tobin Aerial Surveys, $37,998.55. Texas — 7,622 square miles; Aero Service Corporation, $16,-920.84.

HANGAR IN THE TREES: Most recent addition to attractive du Pont Airport is the new hangar at the right.

SOUTHERN HOSPITALITY: This year's turnout at Steadham Acker's Tenth Annual National Air Carnival.

INCREASED PRODUCTION: A modern assembly line and paint shop have been installed in Luscombe's new factory building. Production manager is Henry F. Boller.

TAIL WHEEL BRAKE: Bicycle parts are used in this tail wheel brake devised by operator A. J. Baxter at Floyd Bennett.

Seaplane service for Glen Haven, on Irondequoit Bay is now available at the new base opened by the Rochester Seaplane Service, Inc. Flight instruction, charter, and passenger service and a licensed mechanic are available. Officers are: Robert T. Searing, President and General manager; Adolphus Boice, Vice President; Sandy Lindsay, Secretary and Flight instructor; and Martin Steiger, Treasurer.

An excellent program is developing for the sixth meeting of the Northwest Aviation Planning Council at the Olympic Hotel, Seattle, Washington, October 5, 6, and 7. Visits to the Boeing plant, Naval Air Station, and McChord Field, and addresses by inter-national aviation figures are planned.

Full recognition of the Licensed Airmen of America as a National Division of the National Aeronautic Association, has been announced by Charles F. Horner, N.A.A. president. The Licensed Airmen of America is an organization of Southern California aviation people holding certificates issued by the Civil Aeronautics Authority. It is non-union, nonsectarian, and non-profit. Under the newly granted authority it is seeking to form other N.A.A. chapters.

An 855-ft. pile of catalogues has just been turned out by Karl Ort and it cost him plenty. So he is asking as usual that one small, thin dime be sent to insure receiving your copy. Even if you don't send an order for something in the book (and our guess is you can't resist it) there is more than a dime's worth of window shopping value in it.

Air Progress will be observed under N.A.A. sponsorship Sept. 11–24 according to a recent announcement by President Charles F. Horner. At least 1,000 cities are expected to participate.

PFA has been fighting against exclusion of all but scheduled airliners from New York's North Beach Airport when it opens. Conferences have been held with the airport manager and others and members are awaiting the decision. Among the other varied activities of PFA is publication of a "Civil Aid Digest," a handbook for flying students.

First Fatality

C.A.A. Student of N.Y.U. Group Crashes at Bendix

While C.A.A. students were cramming to pass college examinations and qualify for private certificates, the experimental program suffered its first fatality. Paul Faber, of the N.Y.U. group training at Bendix Airport, had just completed three periods of dual and solo spins and was coming in for a landing when his ship stalled and fell off from about 50 ft. He suffered a fractured skull.

Investigations are underway by Grove Webster, chief of the C.A.A. Private Flying Division and Capt. Gil Rob Wilson, New Jersey's Aviation Director. At the time of writing "training-fatigue" seems to be suspected as the cause of the accident and orders have gone out to all C.A.A. training centers that students' daily flying shall not exceed one hour of general instruction or one-half hour of acrobatics.

On June 9th six Pomona Junior College students qualified for private pilot ratings in tests given by CAA inspector Calvin Johnston at Monrovia Airport, where fourteen selected boys have been taking flight instruction under the tutelage of instructors Bill Feast and Chuck Ludwig. Leo Sullivan, Jack Hagen, Ralph Harper, Norman Vogt, Dick Bartlett, and Jack Arrington, the six who received certificates, all have their eyes on Army Air Service careers. The eight remaining boys of the group will be put through their tests June 16th.

Ryan Engineering students are running smoke tests in the Ryan wind tunnel on a new type slotted wing which will probably be subjected to flight tests in the near future. The slotted wing was designed by a special advanced engineering group consisting of Ed Baumgarten, William Brown, Walter Gafner, William Immenscho, Ralph Swift and Fred Thudium, and is being tested by this group under the direction of Stanley H. Evans, director of the Ryan engineering school, and himself widely recognized for his achievements in the design of wing slot systems. The Ryan smoke flow tunnel was built recently by students in the mechanics division of the Ryan school.

A complete chemistry laboratory has been opened in the engineering building at Aero Industries Technical Institute, Los Angeles. Fully equipped for both qualitative and quantitative analysis, the laboratory will specialize in the study of aircraft metals and materials. Under the direction of K. L. Miles, graduate of California Institute of Technology in metallurgy, the Aero chemical laboratory is being used to a considerable extent for commercial research work for nearby aircraft plants, as well as for advanced instruction.

C.A.A. Flight Training Log As Of June 10

Name	Quota	Total Hours Logged to Date	Number of Students Soloed	Tests Passed
University of Alabama	30	1116¾	30	30
Georgia School of Technology	30	615	30	2
Kansas University	20	698	20	12
Mass. Institute of Technology	20	479	20	2
University of Michigan	20	705	20	6
University of Minnesota	20	524	19	..
New York University	30	677	30	..
North Carolina State College	20	690	20	12
Pomona Junior College	15	441	15	..
Purdue University	50	1934	50	36
San Jose State College	15	543	15	..
North Texas Agri. College	30	957	30	24
University of Washington	30	497	21	..
Totals	330	9859	320	124

TAGGING THE BASES

with LES NEVILLE

Light Planes Can't Win Against the Atlantic

There is nothing more deplorable in this whole aviation business than the epidemic of suicide flights over the Atlantic that has broken out as a result of the widespread attempts to emulate Douglas Corrigan. Two days after Corrigan's flight a frantic father called us to plead with us to dissuade his boy from such an attempt. Ever since plane manufacturers have been besieged daily by letters from Atlantic aspirants some of whom have not yet really learned to fly. There are two things these foolhardy young men fail to realize: (1) that Corrigan had made much more preparation than he admitted (2) that he accomplished his purpose on pure, unadulterated luck. Neither do they realize that carburetor icing conditions are frequently met in the summertime and that smaller airplanes can't possibly carry enough fuel to combat the unexpected in transatlantic weather. It is a difficult problem to prevent people from killing themselves if they are intent upon doing so. And it is only through the closest cooperation of airplane manufacturers, airport managers, and the Civil Aeronautics Authority that this needless slaughter can be prevented.

We were just about to shout about the one hundred percent safety record of the first phase of the C.A.A. Training program when we were shocked by the news of Paul Fabers' fatal accident at Bendix. We have been watching the experimental program closely and we know that many of the boys were under considerable pressure because of the concidence of college and flight examinations. This seems to be a very reasonable explanation of the first fatality. Up to the time of this accident the C.A.A. program had established an excellent record. Statistically a single fatality out of 10,000 hours of training is still a good record for this country and far better than that of many other countries abroad. But the C.A.A. cannot be satisfied with anything less than a perfect no-fatality score.

Invisible airplanes with jump take-off and vertical landing equipment are the only ones that may use Dycer-Southwest Airport in Los Angeles if Supreme Court Judge Roy V. Rhodes' decision is sustained in the case of the City of Los Angeles vs. the airport. Judge Rhodes' decision is reminiscent of the days when automobiles were condemned because they frightened the horses. It proclaims that no plane landing or taking off shall be so close to or visible from Western Avenue as to cause congestion of traffic. Other provisions are that 36 acres of the field must be paved to make them dustproof and landing planes must keep above 500 ft. at airport boundaries. If these are good reasons for closing an airport, this learned jurist will find a good many to close.

STUDENTS AT WORK: Test work at the American Schools of Aircraft Instruments.

ARKANSAS TRAVELERS: (left to right) Ernest L. Bailey, Capt. Charles M. Taylor, and Buck Carter during the 12th Annual Arkansas Air Tour.

Who's Who in Airline Maintenance

(*Continued from page 23*)

der, when Chief of Airline Inspection of the Bureau of Air Commerce, attended several of these conferences as did Colonel J. Carrol Cone. Major Schroeder saw to it that the Maintenance Inspectors were authorized to attend.

By the time of the Deroit conference, the trend was "whole hog" in favor of calling manufacturer's representatives before the Conference. All those who wanted to be heard were called in when the subject on the agenda pertinent to their product was up for discussion. This took a lot of time and was valuable to the committee provided it had not heard approximately the same story before. No manufacturer to date has broken down the policy of adhering strictly to facts rather than indulging in fancy selling arguments.

At subsequent meetings we endeavored to have the vendor's representatives qualify and used the questionnaire method in which we asked what new developments they had to tell us about since the last meeting or if they had anything to report as the result of the discussion at the previous conference. Al Binnie of Kollsman, for example, reported at the Hollywood meeing on radium indicator discoloration. Jack Peace, formerly of Sperry and succeeded by Swisher, has come into conferences with definite data for the committee based on what was discussed at former meetings. Mr. Swisher has done a good job along these lines since.

It is the feeling that this procedure keeps the manufacturers "on their toes" and further does not compete or duplicate in any way the good job being done by the S.A.E. and the Institute of Aeronautical Sciences where the procedure is the delivering of papers followed by discussion.

The recent Maintenance meetings—one recent one, they tell me, had too many speeches—have had some of this but the emphasis is on licking troubles, doing the job better and more economically.

Each meeting seems to have a theme song; 110 A.C. was the biggest thing in the minds of the boys at one conference. Sticking rings and burnt valves was another; more time out of spark plugs has had its share of attention. Now its steel rather than dural crank cases. Once it was anodization instead of Alclad—now its alclad and how to clean it, and Fred Pyne of the Aluminum Company has told the committee how. Master rod bearings are now giving little trouble; they did a while back.

It is strange how one air line might have trouble with a given gadget when no one else is. By means of the free, informal, and open discussion without a gavel or a chairman who is the least bit familiar with Roberts Rules of Order, more often than not the air line having the trouble will have a solution before the meeting is over. There is some difficulty now with cylinder hold-down studs in certain engines. Cap screws may be the answer. The committee will find out by the next meeting. Or perhaps the answer will be Harold Thomas' torque wrench being developed by the Elastic Stop Nut Co.

We have had a somewhat difficult time getting out proceedings of the meetings and have tried all sorts of systems, using relays of stenographers, and, at the first several meetings, with the help of S. Paul Johnston's editing, the writer wrote them up without benefit of stenographer. This became impossible when it was necessary to usher in the manufacturers at the appropriate time. Fortunately, in recent years the writer has some perfectly marvelous helpers in this regard. "Sully" of the Navy and Lt. Ed. Perrin report to the Secretary of the Navy and the Chief of the Material Division, respectively, upon their return from the conferences. The notes which they have to write up anyway are turned over to me and are used as a check on my own. At the New York conference, Mr. John W. Crowley, Jr., Senior Aeronautical Engineer of the N.A.C.A. kept copious notes from the viewpoint of what the N.A.C.A. could do to help in the air lines problems. Then it is only polite to let the vendors check the notes attributed to them. It takes time to get the replies returned and something of a puzzle to put the results together. S. Paul Johnston, mentioned previously, is an honorary member of the committee for services rendered over a period of years. Paul has been a diligent and gracious editor of the minutes of the meetings as an extra curricular activity to that of being editor of AVIATION. The annual air line maintenance award is his baby.

Credit should be given to Larry Kerber, now of Lockheed and formerly of the Bureau of Air Commerce and the C.A.A., Dick Gazley, Irving Metcalf, "Jock" Easton, C. P. Reed, Phil Salzman, Oscar L. Wallace, George Lossow; Gaylord Newton, Jack Gray, Oliver Rosto, Jerome Annis, and many others of the C.A.A. and former Bureau of Air Commerce for their valuable contributions to the committee over a period of years. Also much credit should go to Casey Jones, Oliver Parks, Lew Churbuck, T. Lee, Lewis Holmes and Major Moseley, as well as Abby Wolf, and the aviation schools he represents, for the manner in which schools have collaborated and kept up-to-date in training the young men needed by the air lines for the maintenance and overhaul of equipment.

There is a lighter side to these meetings, the business sessions of which are three days of hard, intensive grind. Some relaxation is necessary. Royal Sundell was a marvelous host at Brownsville and arranged some interesting and innocent entertainment at Matamoras. Clarence Belinn, who chairmaned a highly productive committee on standardization, and the clam bake he arranged in New England will go down in history. Tom Colby and his Saturday evening party on Lake St. Clair after the Detroit meeting adjourned will be long remembered. Tom Braniff's and Committee Member Reagan Stunkel's arrangements at Dallas were perfection. American Airlines and Colonel Gorrell gave a swimming, horseshoe throwing, badminton, and archery barbecue on Lake Michigan in July after the Chicago meeting. One hundred delegates indicated they'd be there, one hundred seventy-one showed up, for which the hosts fortunately had provided and would have been glad to have more.

Maintenance Chiefs

The Maintenance Chiefs of some of the smaller and medium-sized lines have developed forensically and in the manner in which they take an interest and prepare data for the meetings. "Doc" Anderson of Chicago and Southern delivered a paper at Dallas on the problems of a shop of its size, which paper has since been widely called for. Mr. Paul Briggs of Continental and R. N. Benjamin of Mid-Continent have both been active and effective in the work of the committee, as has the veteran Jim LaMont and

(*Turn to page 90*)

CURTISS P-40

CURTISS P-36A

CURTISS YP-37

Curtiss

ELECTRIC PROPELLERS AGAIN SELECTED FOR U.S. ARMY PURSUIT AIRCRAFT

• Curtiss Electric Propellers have been selected by the U. S. Army for use on the new Curtiss P-40 and Lockheed YP-38 Pursuits, quantity purchases of which were recently announced by the U. S. Army Air Corps. The Curtiss P-40 order represented the largest number of airplanes ever purchased by the Army in peace-time.

Curtiss Electric Propellers have also been selected for the following Pursuit Airplanes of the U. S. Army Air Corps:

P-36A	XP-40
YP-37	XP-41
XP-38	XP-42
XP-39	YP-43

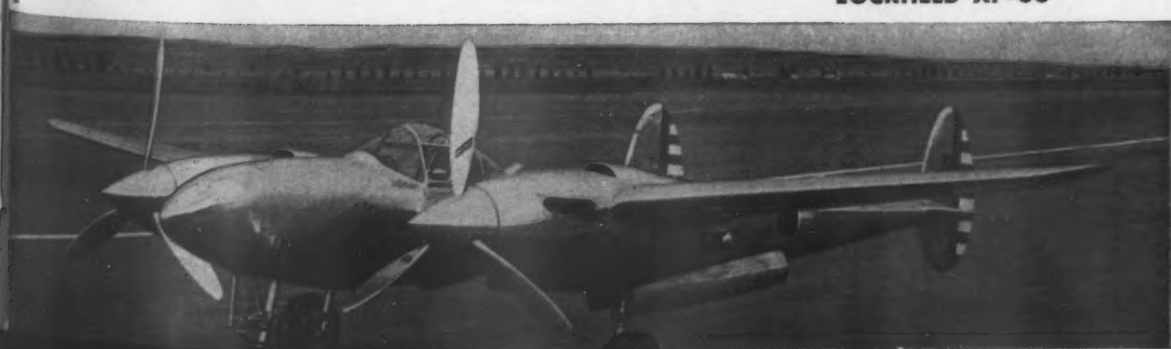
CURTISS WRIGHT CORPORATION
CURTISS PROPELLER DIVISION
CLIFTON, N.J.

LOCKHEED XP-38

BELL XP-39

CURTISS XP-40

LOCKHEED XP-38



PHOTOGRAPH of the XP-41, XP-42 and YP-43

Who's Who

(*Continued from page* 88)

his two colleagues, H. G. Aune and Lew Koerner at Northwest Airlines. At the Boston meeting all present were intrigued by the job being done by Committee Member Clarence Belinn, with average stops on the system each 30 minutes or so of flying time. He should and does know more about landing gear mechanisms than anyone in the business and he has many tricks up his sleeve for saving money consistent with doing a good and safe maintenance job.

Reagan Stunkel, who has been a participant in the work of the committee for many years, when with Bowen Airlines—Bill McDuffie now of the CAA Safety Board Staff was then his boss and a member of the committee—was the proud and efficient possessor of one of the best equipped medium-sized shops anywhere which is the Braniff base at Dallas. Reagan recently joined the ranks of vendors (Vega Airplane) and has been succeeded as a committee by Stanley Shatto. Jim King of Western Air Express is an old reliable and has contributed in an extremely worthwhile way. Peter Hubert of National Airlines (Florida) has been missed at recent conferences as has Jim Hill of Wilmington-Catalina. Tommy Siers of Canadian Airways and George Ponsford, Director of Aviation for the Province of Ontario, are welcomed, have contributed, and they claim to have taken away some valuable information toward doing the difficult jobs they have to do. Bill Miles of Delta has done an excellent job in maintenance and attributes a good share of it to the conferences and the interim notes which are circulated as a result. Buck Weaver and Bill Hoare of United are also most enthusiastic workers for the success of the conferences. At the last two meetings Purchasing Agents of the air lines have been in attendance and have either preceded or followed the conferences with meetings of their own. The Purchasers are thus better acquainted with the problems of the men for whom they purchase.

The informal dinners with toastmastership by Casey Jones, entertainment by Doolittle and others, always on a Dutch treat basis, have been masterpieces in the annals of aeronautical affairs and are so conceded by such honored guests as Lester Gardner of the Institute of Aeronautical Sciences and Lew Palmer of the National Safety Council.

Mr. William Littlewood, Chief Engineer of American Airlines, is Chairman of the Committee for the forthcoming two meetings. The next one on June 12 through June 14 is to be held at Santa Monica, California.

Colonel John H. Jouett, President of the Aeronautical Chamber of Commerce, and Mr. R. W. Ayer, Manager of the Technical Division of the Chamber, have been co-operating closely with the Committee through the various technical Committees of the Chamber of which Mr. Ayer is secretary. There is a constant exchange of green sheets, an appropriate color for safety and on which all Engineering and Maintenance Committee memoranda are mimeographed, between not only the air lines, but also to manufacturers, toward the betterment of the products used by the air transport industry and on which the manufacturers have co-operated with enthusiasm.

Maintenance

(*Continued from page* 53)

engine repair work it is necessary for the Curtiss-Wright Technical Institue, Grand Central Air Terminal, Glendale, to maintain a large shop for instructional purposes alone. It has been found an ideal arrangement to use this equipment, and the students, to perform actual maintenance and repair work on aircraft and engines, and for this purpose Curtiss-Wright maintains an approved repair station. Many damaged aircraft have been completely rebuilt and a great deal of maintenance work is done on all types of planes and engines.

These are but a few examples of the larger maintenance bases not operated by the airlines. There are many others. One of the finest overhaul bases in the east is that operated at Caldwell Essex Airport in New Jersey. Excellent facilities are maintained on East Boston Airport by Inter City Airlines, and others. Among the many on Roosevelt Field, the engine overhaul shop of Chuck Foley and Pesters Propeller Service are particularly worthy of mention. At Cleveland General Airmotive Corporation, under Jim Borten's skillful guidance, is preparing for this years air race work and for future expansion. There is plenty of activity in the shops of Sundorph, Skyways, H. C. Robbins, Ellison, and Aircraft Service. We could mention many more but space limitations prevent.

The business of servicing airplanes, engines, and equipment is a good one and there is money to be made in it. Many methods have been devised to save time but not at the expense of quality. A heavy responsibility rests upon the shoulders of the maintenance man but his rewards are directly proportional to service rendered.

G-200 Cyclone

(*Continued from page* 56)

volute spline generator mount is provided in this section.

Greatly improved bearing surface to withstand the loads between master connecting rod and crankpin is provided by the "End Sealed Master Rod Bearing", which is now standard with G-200 Series Cyclones. The End Sealed Bearing now carries oil to the knuckle pins through external passages, eliminating the necessity of drilling the bearing and thus breaking the oil film at any point. Lubrication of the master rod bearing is further improved by sealing at each end, which prevents oil from being thrown off before reaching the loaded area of the bearing. Lubrication to the cylinder walls is now supplied through two special jets in the crankshaft.

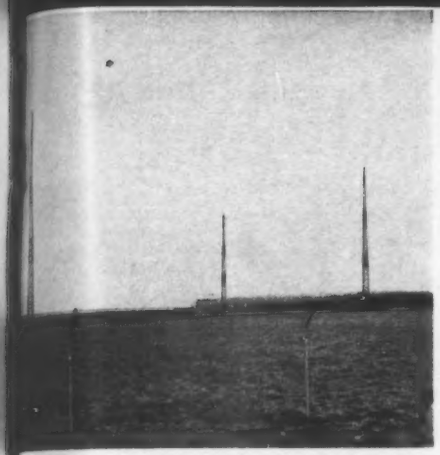
The crankshaft is of the conventional two-piece design with the rear crankshaft bolted onto the crankpin. An innovation in the G-200 Cyclone crankshaft, however, is the incorporation of Wright dynamic damper in both counterweights.

Pistons for the G-200 Cyclone are aluminum alloy forgings with six ring grooves instead of five. There are grooves for three compression rings and two oil scraper rings above the piston pin and the conventional oil scraper groove. New coil spring piston pin retainers hold the pins in place in conjunction with a hardened chamfer provided at each end of the piston pin.

Accessory drives are similar to those of the G-100 Cyclone except for the square pad spline drive fuel pump mount on the rear section and the tachometer and governor control drive on the oil pump. Speed ratio and direc-

(*Turn to page* 95)

RIGHT ON THE BEAM · WITH WESTINGHOUSE



Radio range station at North Platte, Nebraska, showing three of the five vertical antennae. Building housing the transmitters is shown at base of antenna at right.

Strong and resistant to wear, stains and scratches, Westinghouse decorative Micarta table tops are ideally suited to the lightweight requirements of modern aircraft.

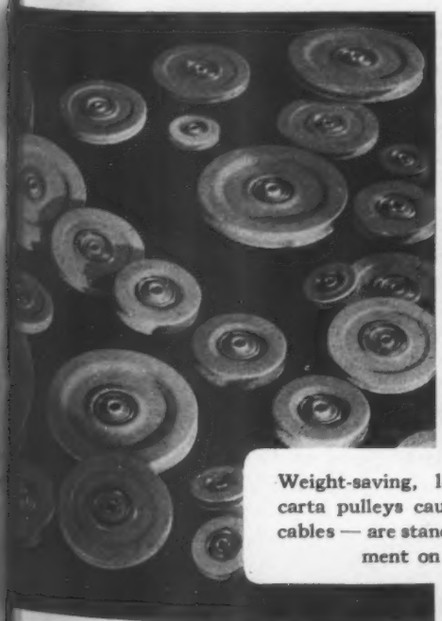
MAJOR AIR LINES PROTECTED BY Westinghouse Beams

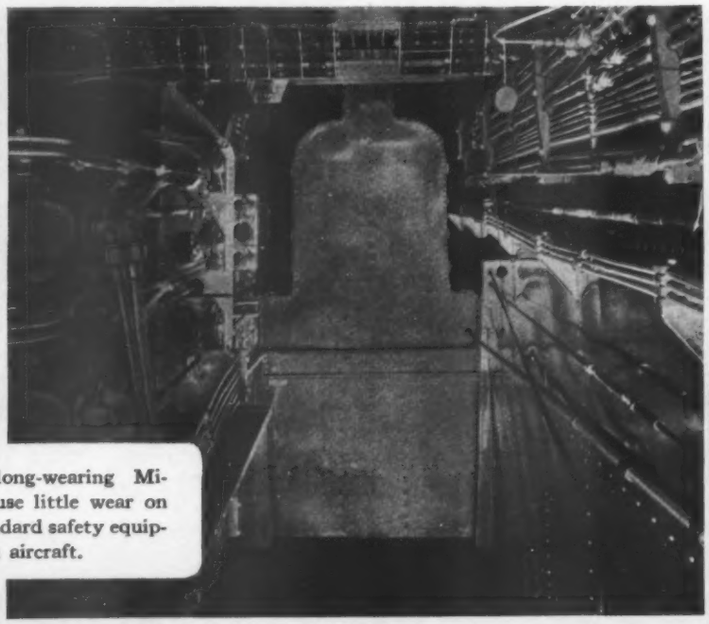
OF MAJOR importance to aviation operators, pilots and passengers are the accomplishments in flying schedules and safety.

Among these major accomplishments are the 94 Westinghouse Radio Range installations approved by the Civil Aeronautics Authority of the Department of Commerce. These Radio Range Beacons will span the United States from coast to coast — marking a distinct step forward in flying progress . . . and this company is proud to have co-operated in this pioneering achievement. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania.

Interior view of North Platte station, showing Westinghouse beacon equipment, including phantom antenna, transmitter and station control racks.

In addition to standard instruments, Westinghouse offers special instruments such as the Cross Pointer type for blind landing systems, right and left indicator, and other applications.





Weight-saving, long-wearing Micarta pulleys cause little wear on cables — are standard safety equipment on aircraft.

Send for your copy of "FLYING"— the new and interesting Westinghouse book on Aviation. Simply fill in and mail the coupon below.

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J-933

Westinghouse

A 500 Cycle Blind Landing System

(*Continued from page 61*)

erator also supplies to conductor 2 sufficient current in opposite phase to the current of conductor 1 to cause the resultant magnetic field surrounding cables 29 and 30, in the area between conductor 2 and the landing point, to diminish in proportion to the amount of convergence of cables 29 and 30 in the area between conductors 2 and 3. In a like manner, sufficient current is caused to flow through conductors 3, 4, 5, 6, etc., in opposite phase to the current in conductor 1, to cause the resultant magnetic field surrounding cables 29 and 30 to diminish in proportion to the convergence of those cables. The impedances are used to adjust the magnitude and phase of the currents in the various circuits and the ammeters measure the magnitudes of the currents. This design provides positive control of the currents in each circuit of the ground system from a central point.

The cross conductors, 1, 2, 3, etc., are spaced apart a distance approximately equal to the desired height of the glide path above the mid-point between them. Using this spacing no flutter of the cross pointers is apparent during descent. In the case of the Lakehurst installation there are 27 cross conductors. The altitude of the glide path above conductor 2 is 800 feet and the distance from conductor 2 to the landing point is 8000 feet, thus providing a 10 per cent downward slope for the glide path. The length of the horizontal glide path between conductors 1 and 2 is 1000 feet. The current in Conductor 1 (#8 B&S gauge) is 8 amperes. The remaining conductors in the multi-conductor cables 28 and 29 are #19 B&S gauge. The cross conductors are #14 gauge. The total power required for the Lakehurst installation is 1.25 kilowatts. The total cost of all materials, installation, and two complete aircraft equipments was approximately $7,500.00. The weight of the Aircraft equipment, including collector loop and 8 pounds of "B" batteries, is 29 pounds. It is planned to eliminate the batteries, to design lighter collector loop cables and to reduce the total weight to about 10 pounds. The two-channel audio amplifier is approximately a 6-inch cube and weighs 8 pounds.

It is of particular interest to note that this system permits the establishment of a glide path of any desired shape or conversely, the cables may be paid over hills and valleys and yet a straight line glide path may be established. The Lakehurst glide path is straight as shown in Figure 2.

Installing Collector Loops

Figure 5 shows the most simple and effective method of installing the collector loops in the aircraft. An imaginary plane is passed through the fuselage of the aircraft in such a manner that this plane makes an angle of 45 degrees with the lateral centerline of the fuselage. To the inside walls of the fuselage along the line intersection of the imaginary plane with the fuselage, there is secured a small flexible, fabric-covered multi-conductor cable of the inter-phone type commonly used by the Telephone Companies. The diameter of this cable will range between a quarter of an inch for one containing 20 conductors to a half an inch for one containing 100 conductors. The cable having been secured to the walls of the fuselage so as to describe a complete loop and return to its starting point, the various conductors of the cable are connected in series so as to form a multi-turn loop which offers little or no obstruction to the finish of the fuselage and is practically unnoticeable. In the same manner, a second loop is installed at right angles to the first. Experiments have definitely shown that a metallic fuselage has no effect on the proper operation of these loops.

At Lakehurst, one course of a low power, intermediate frequency, crossed-loop type A-N radio beacon or localizer is used to guide the pilot to the entrance of the glide path from a distance of 10 to 15 miles from the airport. Using this localizer and the barometric altimeter to maintain altitude at approximately 800 feet, no difficulty has been encountered in picking up the glide path at so closely the correct position as to require very little maneuvering to get directly on the glide path. Once on the 500-cycle glide path, the localizer is no longer used.

The multi-conductor and single conductor ground cables are not lead covered, but are rubber covered and have thick jackets of a Tellurium-rubber compound which is thoroughly waterproof and as tough as the tread of an automobile tire. These cables may be plowed under by a cable laying plow or they may lie directly on the surface of the ground. Such cables as these have been buried in marshy ground for four years without showing the slightest signs of deterioration. Figure 6 is a photograph of the control panel by means of which the currents in the ground cables are regulated and measured.

In summation it is well to review some of the advantages of the system just described:

It is simple, reliable and inexpensive.

Operating costs are negligible and no expensive replacement items such as transmitting vacuum tubes are required.

The system is impervious to static and the meter indications are constant, smooth and instantaneous.

It provide a straight, constant-angle glide path or a curved one if desired.

The aircraft equipment is exceptionally small and light in weight.

The simplicity of the receiving equipment, namely an audio amplifier, is such that its constancy of gain is assured. Furthermore, it is a simple matter to provide the amplifier with a self-contained calibrating oscillator which, by means of a push button, may be caused to apply a calibrating signal to the input terminals of the amplifiers at any time that the pilot chooses to reassure himself of the accuracy of the instrument.

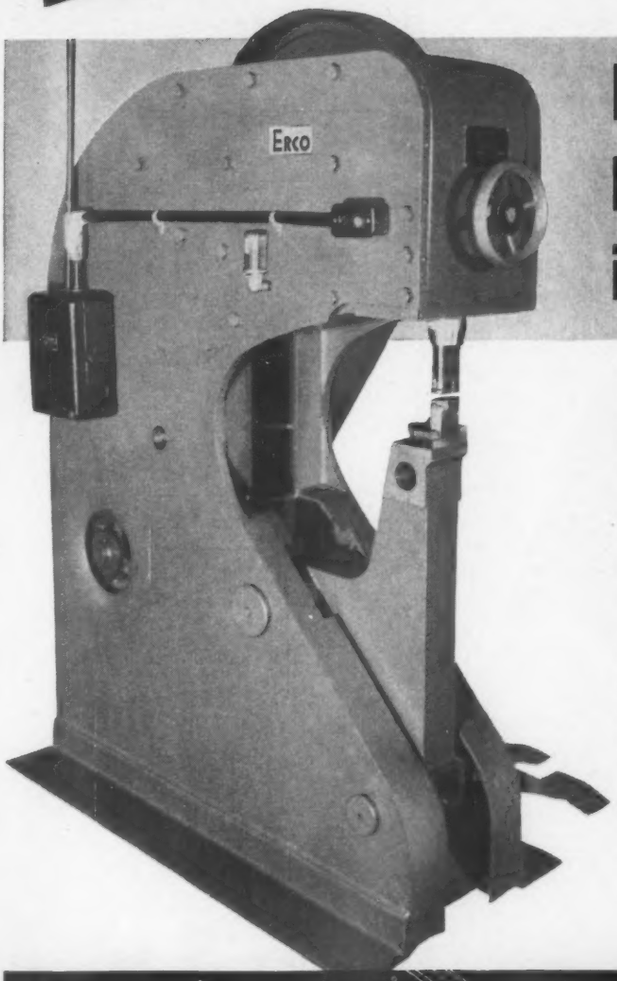
Monitored with AC Meters

The ground equipment is monitored solely by the use of a few AC voltmeters and ammeters. Once adjusted it remains adjusted and is unaffected by changes in ground conditions from wet to dry and from snow to clear.

All ground equipment may be under-ground and will not constitute a hazard to flight operations.

The one possible disadvantage of this system lies in the necessity of extending the cables beyond the boundaries of the smaller airports. This factor is, however, not as serious as it first appears to be. Easements for the permanent installation of cables under or over the property of neighboring land owners are easily and inexpensively obtained and are so obtained almost daily by the power companies and wire communication companies.

New ERCO SHEET METAL SHRINKER!



Forms sheet metal by reducing its length in localized areas . . .

HERE'S the answer to your need for a machine which will change the shape of a piece of metal by shrinking it in localized areas. This procedure, an operation as useful and varied as bumping, can now be performed accurately and simply on The Erco Shrinker. This machine is another in The Erco Line of sheet-metal working machines designed especially for aircraft production. Built to the high standards of Erco Machines, it will operate for years silently and efficiently.

Jaws are instantly removable and interchangeable. They are built with various surfaces and shapes for a variety of materials and uses. *Write for Bulletin MS which fully describes the new Erco Shrinker.*

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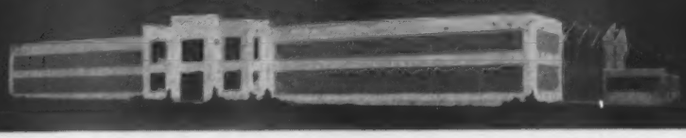

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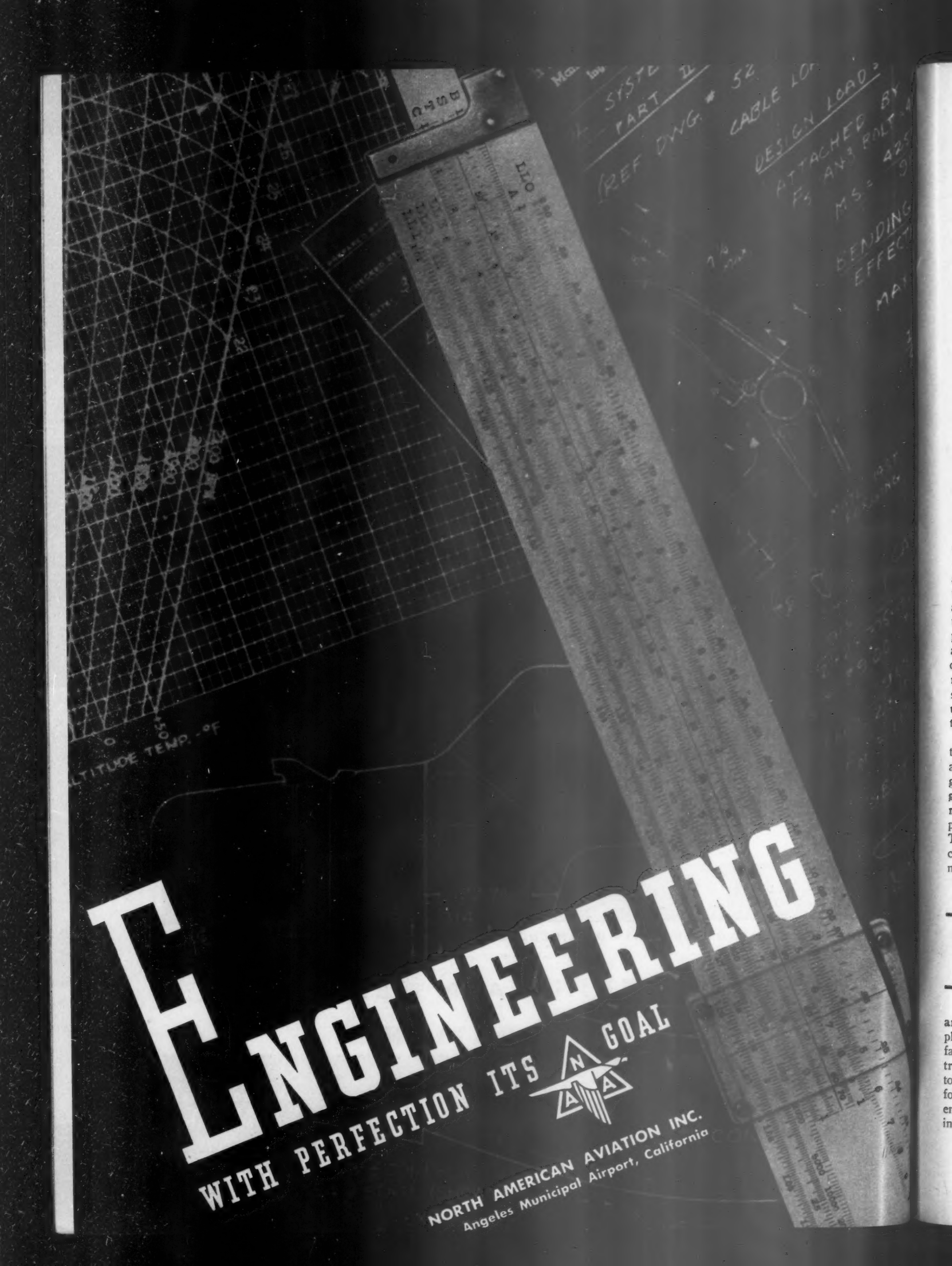
ENGINEERING
WITH PERFECTION ITS GOAL
NORTH AMERICAN AVIATION INC.
Angeles Municipal Airport, California

G-200 Cyclone

(*Continued from page 23*)

tion of rotation of the various drives is as follows: Starter—1:1; Acc. Drive Box—1.5:1; Generator—1.5:1; Magnetos—1.125:1; Gun Synchronizers—16:9 or 3:2; Fuel Pump—1:1; Tachometer—1:1; Governor (Curtiss)—1:1; Governor—1:1.

The induction system is basically the same as on the G-100 except for passages which have been enlarged and "streamlined" as previously mentioned. The supercharger drive is identical with late G-100 Cyclone engines equipped with the Wright two-speed supercharger, providing for a low impeller speed ratio of 7.14 to 1 and a high speed ratio of 10 to 1. Fuel metering is supplied by a Stromberg non-icing injection carburetor designed as Model PD12B5.

Ignition is supplied by the conventional two magnetos, the left magneto firing the rear nine spark plugs at 20 degrees BTC and the right magneto firing the front nine spark plugs at 20 degrees BTC. Magnetos are of the Scintilla type SF9L-3 and incorporate a compensated spark timing arrangement for equal advance on all cylinders. A Breeze stainless steel magneto and ignition wiring assembly, assembled in front of the push rods is used. Spark plugs are of the BG298GS type.

The 16 to 9 gearing is the conventional type using 20 small pinions to affect the reduction between the bell gear on the crankshaft and the sun gear in the nose section. The 3 to 2 reduction gear unit uses six large pinions to affect the speed reduction. The propeller shafts in both cases include accommodations for a Hydromatic propeller.

Ken-Royce Model 7F

(*Continued from page 58*)

are located in the same transverse plane. The cam followers are manufactured from SAE 4130 steel, heat treated to give both hardness and toughness. The followers are drilled for lightness and receive at the outer ends of a push rod ball socket pressed into place. Special lock screws prevent the follower from dropping out when the push rods are not in place. A pad finish machined at the lower side of the crankshaft provided with studs permits attaching the oil sump.

The cylinders on the Model 7F, like those on Model 5F are composite in construction, the barrels being manufactured from 4140 heat treated steel forgings, the heads being heat treated aluminum alloy castings. The head is attached to the barrel with a special patented joint which is so designed as to obviate necessity for a gasket between the two. As the aluminum expands, it tightens against the steel barrel. The head is held in place by twelve studs and need never be detached. The inner end of the barrel extends into the crankcase a distance sufficient to prevent over oiling the lower cylinders. The combustion chamber is spherically shaped and is finish machined after bronze rings for the valve seats are shrunk and penned into place. The axes of the valves are inclined at an angle of 30 deg. to the cylinder axis, the valve seats being 45 deg. Removable bronze valve guides are pressed into the cylinder. The valve springs are interchangeable and are of the volute ribbon type. Each valve is held by a split retainer seating in the valve spring collar. A wire safety ring secures the valve stem just below the collar to prevent the valve dropping into the cylinder. The cooling fins in the cylinder head are of the pompadour type and efficiently arranged, with the result that even when the engine is used under full N.A.C.A. cowling, head temperature is remarkably low. The outer surface of the barrel and head is covered with glossy black enamel after the two are jointed. The cylinder bore is held to exact limits and is finish machined by honing.

Tulip type valves are used. Rocker boxes, interchangeable on all engines, are mounted on a pad concentric with the axis of each valve. This construction has a special advantage in permitting the end of the valve stem and the axis of the rocker arm to be held in the correct relationship at all times by the proper selection of shims for the joint between the two. The rocker arm shaft is carried on ball bearings provided with special cylinders for retaining the lubricant. A Zerk fitting on one side provides a means for lubricating both bearings. Between the enclosed rocker boxes and the cam follower bushings in the crankcase are telescopic tubes which fully enclose the push rods. The length of the push rod may be readily adjusted for proper tappet clearance.

Gearcases are interchangeable on production models. Pads are provided at the top of the gearcase casting for mounting the magnetos and below a flange is provided for attaching the oil pump. A central boss supports the cam drive shaft. The magneto shaft lies above and at right angles to the cam drive shaft. A cast aluminum alloy cover closes the opening at the rear of the gearcase and is held in place by eight studs. The oil pump is built up from a lower body, an upper body, and a plate, all parts being aluminum castings. The pressure gears are located in the upper body and the scavenger gears in the lower body. As oil leaves the pressure pump body, it must pass through a cylindrical screen of fine mesh which is held between the upper body and the plate. Once through the screen, the oil can enter the drilled openings in the gearcase which lead to the bearings or to the pressure relief valve. Excessive oil from the pressure pump passes through a relief valve and re-enters the inlet side of the gears.

The Ken-Royce Model 7F engine is equipped with Bendix Stromberg carburetor. The engine may be equipped with either Model M-3-1 or No. 13 spark plugs made by the Champion Spark Plug Company or with BG Model 4B-1 spark plugs made by the BG corporation. All models of Ken-Royce engines are equipped with dual ignition and are equipped with two magnetos manufactured by the Scintilla Magneto Company. These magnetoes have radio shielded ground terminals as standard equipment. All engines may be equipped with radio shielding as special equipment. The Model 7F, as well as the 5E and 5F is equipped with specially designed piston rings of the tin plated type manufactured by the McQuay-Norris Company.

Specifications for Ken-Royce (LeBlond) Models 5E, 5F and 7F follow:

Engine Model	5E	5F	7F
A. T. C. No.	48	46	52
No. and arrangement of cylinders.	5 radial	5 radial	7 radial
Rated brake horsepower at sea level.	70	90	120
Rated Take Off speed (r.p.m.)	1950	2250	2225
Bore	4.125	4.25	4.25
Stroke	3.75	3.75	3.75
Piston Displacement (cu. in.)	230.5	266	372
Compression Ratio.	5.55:1	6:1	6:1
Oil Consumption (#hp. hr.)	.015	.015	.015
Fuel Consumption (#hp. hr.)	.6	.55	.57
Length	23.75	23.75	24.56
Height	37.375	37.375	
Diameter	33.25	33.25	33.25
Weight—Dry Complete without propeller hub	235	226	
Fuel octane	70	70	74

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The Western Electric 25A receiver (right, above) is a light, compact, highly sensitive superhet, covering beacon and weather bands, International Distress frequency, greater part of broadcast band and air transport communication band. Crystal stability is optional. Can also be used with Western Electric loop for direction finding and rain static protection. Weighs only 16 pounds, complete.

The Western Electric 25A transmitter (left, above) is a multi-frequency midget. Simple to operate, it transmits on 3105-6210 KC or any airline frequency between 1400 and 7500 KC. Western Electric high quality quartz crystal oscillators assure accurate transmission. Built-in relay permits use of one antenna for both transmitting and receiving. Weighs only 25 pounds, complete.

For booklets giving full details: Western Electric Co., Dept. 327 A, 195 Broadway, New York, N. Y.

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